AMERICAN
JOURNAL OF SURGERY

VOL. XXXIV MARCH, 1920. No. 3

THE TREATMENT OF CRUSHED EXTREMITIES.*

W. L. ESTES, M.D.,
Chief Surgeon and Director of St. Luke's Hospital,
SOUTH BETHLEHEM, PA.

The Armageddon of the nations has brought traumatic surgery again to the fore. The subject would have furnished little interest and brought scant attendance of surgeons eight years ago.

Of passing interest at last has come to be the conservation of human life and future usefulness after injuries great and small.

The dictum of your Secretary has given to me a large branch of the general subject of today. I wish I had more time to prepare the paper and that today there might be greater opportunity to discuss this most important subject.

A crush I shall assume to mean a severe injury produced by pressure or squeeze—an injury which is ordinarily termed a comminution in surgery. As a rule an injury of this kind involves, more or less, all the tissues of the affected part.

A crush may be local or general when applied to the extremities; this means one or more parts of the extremity may be involved or the whole extremity may be affected. There are, too, various grades of severity. A crush may be, and generally is, produced (1) by some force applied from without or (2) it may result from the pressure of a person's own weight, by the momentum obtained in a fall from a height or the projection from a rapidly moving machine.

It is important to keep these general facts in mind in discussing this difficult subject of crushed extremities.

The first effect of a crush is usually shock. The immediate shock is frequently quite out of proportion to the extent and severity of the injury, because in many instances it is psychic shock.

Hemorrhage is rarely serious immediately after a crush because (1) of the shock and (2) because the vessels if divided are squeezed or ground asunder. This presses the severed coats of the vessels together and in the weakness of shock this prevents immediately serious hemorrhage. Later, however, hemorrhage may be very severe. The absence of hemorrhage soon after these injuries has led physicians into the grievous error of neglecting measures to control bleeding. Many times have I been told by physicians who saw the case soon after injury: "I did not put on any tourniquet, because there was no hemorrhage." The result follows that in transporting the patient some distance "reaction" comes on and he bleeds to death before he reaches a hospital.

Practically every serious crush results in a serious potential infection. If the injury happens along a street or roadway, in cultivated fields, or in a residence occupied for many years the infection is apt to be from the tetanus or gas bacillus, probably from both. If it happens in a factory or machine shop it is apt to be a coccal infection—staphylo or strepto-coccal. Miners rarely have any serious initial infection, except in the stables; they may be infected by careless or ignorant handling after the injury, however.

The management of crushed extremities comprises, in the order of what seems to me the proper sequence, the following:

1. The control of hemorrhage.
2. Treatment of shock.
3. Measures for disinfection of the wound and immunizing the patient.
4. Treatment of the injury itself.
5. Measures to restore function and usefulness after recovery.

1. THE CONTROL OF HEMORRHAGE. — This should be the special care of the person who renders first aid, and it is the indication before all others for treatment—if the injury has involved any part of the extremity above the fingers or toes.

As it was said above a crush will not result in immediate bleeding because of the weak heart action in shock, and the fact that the continuity of the vessels has been *pressed* asunder. This is true even if the crush has evulsed the limb. When, however, reaction takes place free bleeding witl occur. This should be forestalled when it is possible to do it. This acceptable time is during the period of shock. The initial control of hemorrhage should be by a tourniquet or by a large compress upon the wound and a firm bandage to hold it in place applied from below upward. The nature of crush

*An address delivered at the twenty-ninth annual session of the New York and New England Association of Railway Surgeons in New York City, October 20, 1919.

wounds, however, require tourniquets rather than compresses or direct packing of gauze into the wound.

The placing of the tourniquet is a matter of great importance if it is necessary for it to remain in place for any length of time. The general rule should be to place the tourniquet over the *injured* tissues above the severed vessels just as near the wound as it may be placed in order to be secure.

As the bone or bones are usually fractured in crushes and it will be necessary to use a splint for transporting the patient, a good method of applying the tourniquet is as follows: Select a splint not quite as wide as the diameter of the injured part, apply this alongside the limb, place sterile gauze over the wounded area and then apply the tourniquet over and around the splint and limb. The splint will prevent circular pressure over the whole periphery of the limb, but will allow sufficient pressure over the wound and severed vessels to prevent bleeding, without devitalizing constriction, which would result in death of the tissues below the injury if left on for a period of hours.

At a proper dressing station or in the operating room severed vessels may be caught by hemostats, but they should not be ligated unless the wound has been thoroughly cleaned and disinfected.

2. SHOCK.—Physiologists and surgeons are not agreed as to the nature of shock. I have been deeply interested in the publications of Porter and Cannon in regard to the physiology of shock. Both Porter's and Cannon's theories have been tested by other physiologists and apparently have been disproved. In a discussion of shock (the paper read by Guthrie of Pittsburg at the 1918 meeting of the *Pennsylvania Medical Society* and discussed by Roberts of Philadelphia and Meltzer of New York), Porter's and Cannon's theories found but partial or limited endorsement and other theories were advanced. Guthrie, after mentioning all of the up-to-the-present accepted theories, says in the laboratory none of them has proved generally correct and he frankly says no theory so far advanced will explain all the phenomena of shock, nor will the condition mentioned by writers and experimenters when repeated in the laboratory invariably produce shock.

I myself at present feel more inclined to Crile's exhaustion theory than ever. If this condition of nervous exhaustion has occasionally as one of its phenomena acidosis, and at another time a rapidly developed ptomaine, leucomaine or other poison, with a stasis of oxidation, the outstanding practical fact remains that the condition of shock shows the physical and physiological indication of profound exhaustion. I do not purpose to rehearse here these symptoms and signs of shock; they are quite familiar. Also the ordinary measures for treating shock are so well known that it would be superfluous to rehearse them here.

The key to the situation, in my opinion, is the blood pressure. No serious operative procedure should be undertaken after a serious crush injury if the systolic blood pressure is below 80 mm. One should content himself with the control of hemorrhage and the application of a very careful antiseptic dressing. Then put the patient into a warm bed, apply heat externally, give a warm normal saline hypodermoclysis,—500 cc with perhaps 10 to 15 cc. of 1-1000 sol. of epinephrin hydrochloride. Many surgeons recommend an intravenous injection of the saline solution, and if there is a serious acidosis the addition of bicarbonate of sodium to the infusion. I must warn against the use of intravenous injection except by a very skillful man who thoroughly understands the technic of the administration, and is indoctrinated into the indications for discontinuing it, or for giving more. The fluid must always be given *very slowly* and with little pressure. In the hands of the ordinary interne or the occasional user the method is fraught with danger. I think I have seen several patients hastened out of the world by this intravenous saline solution injection.

I am now very much impressed with the value of proctoclysis, normal saline solution given quite warm (110° F.) by the drip method into the rectum. Primrose of Toronto, and others recommend, as a result of their experience at the front, transfusion of blood. They have found it very effective in many cases.

Whatever method of restoring the strength of the patient be used the operation may be delayed as long as 40 hours with benefit to the patient, and a much better chance of recovery provided serious sepsis does not occur. When the blood goes above 85 systolic presssure the necessary operation may be attempted.

3. INFECTION.—As stated before, practically every crush injury will have been infected. In civil life the infection is not often a gas bacillus nor tetanus infection. As these disastrous infections may occur, it is always well to bear in mind the kind of environment or locale which is apt to produce them. Human and horse excreta especially breed these bacilli: one should inquire diligently as to the surroundings of the patient at the place where the injury occurred. In filthy houses long

inhabited, in highly fertilized fields, and along the highways gas and tetanus bacilli are especially abundant. Also persons of uncleanly habits whose skin and clothing are badly soiled are much more apt to breed these kinds of infections.

I have found that streptococcal and staphylococcal infections are prevalent in injuries which occur in manufacturing establishments generally.

Mines are remarkably free of infectious microorganisms except in the stables or in chambers where mules are fed and housed.

These observations suggest at once the proper line of treatment. If in doubt, it is well to use immunizing doses of antitetanic serum as soon as the case is received.

Most careful efforts for obtaining physical cleanliness should first of all be employed. For greasy, sooty members, benzine or spirits of turpentine should first be used around the wound, then painstaking washing of the wound and surroundings with green soap and sterile water, then disinfect with Dakin's solution or formaline solution, or bichloride of mercury solution. Iodine should not be used when soap and water has just been applied. It will not penetrate, but will be very irritating.

The experience in the great war has taught us the tremendous value of careful debridement of comminuted wounds. The excision of all divitalized tissue, or tissue which almost surely will necrose, while a tedious process, is one not to be neglected in any case where the patient's condition will permit it. Also the removal of all foreign matter, stones, dirt, bits of metal, clothing, etc., is absolutely necessary in order to obtain primary healing and prevent suppuration.

The future usefulness of a member, perhaps the life of the patient, in these cases, depends upon the prevention of suppuration or minimizing the grade of infection. After the removal of all foreign matter and careful excision of the borders of the wound to its deepest part, adequate dependent drainage should be provided and the tissues should be brought into such coaptation that no dead spaces remain, or else the wound should be left freely open. Tension in suturing should sedulously be avoided, else disaster is most likely to occur. I think I have seen more instances of serious suppuration occur when wounds have been brought together by tensely drawn sutures, and from tension of the flaps or tissues about the wound than from any other fault in the modern treatment of injuries. This is an error very commonly committed by internes and surgeons who have not treated a large number of such injuries.

When it is ascertained that an individual when he received the injury was exposed to the possibility of infection by tetanus bacillus an immunizing dose of tetanus serum should be given as soon as the surgeon has received the case. The wounds of these cases ought to be left open, not drawn together by sutures, and they should be exposed for several hours a day to direct sunlight or to white electric light.

If there has been a good chance for gas bacillus infection the debridement and disinfection of the torn muscles, and especially the interspace of connective tissue between the layers of muscles exposed by the wound should be most carefully sterilized by one of the chemical germicides, (Dakin's solution, absolute alcohol, methylated spirits, or bichloride of mercury solution) and the wound also left open and treated by white light.

The enthusiastic acceptance of the Carrel-Dakin method of treating infected wounds by most of the American surgeons who worked at or near the front in the late war and its very general employment at present in civil practice make one hesitate a little to recommend any other method in preference to this most efficient treatment.

Comminuted wounds are those especially adapted to the Carrel-Dakin treatment; because it is very difficult to get thorough coaptation of the tissues, and dead spaces are apt to be left. In spite of painstaking excision of devitalized and soiled tissue one may leave some shreds or fragments behind. It is very well known that Dakin's solution rapidly breaks down the devitalized fragments and causes their release from the continguous parts so that they may be discharged with the fluids escaping from the wound. To use a method which fills in the open spaces at the bottom of the wound with a disinfectant solution which will bring away the devitalized tissue with the discharging bloody serum and which enables one to renew the disinfectant every two hours, seems ideal. It *is* ideal when properly employed for these purposes. But one must not forget he is after all treating the ***whole individual,*** and not the injured member alone, and it requires special training rightly to employ the Carrel-Dakin treatment. The solution must be neutral and it should have the proper quantity of chlorine gas. That requires a skilled chemist to prepare the solution, and it must always be fresh. Unless all this is sedulously provided the Carrel-Dakin treatment is a delusion and a snare. Serious injuries such as major crushes always produce some degree of exhaustion. Rest—physical and mental—is one most important need for rapid re-

cuperation in these cases. The Carrel-Dakin treatment requires frequent changes of dressing. These dressings are usually painful and tedious. The patient soon learns to dread the ordeal of the dressings, so that the prosecution of this method which entails frequent attention takes away the strength of the patient and adds to his exhaustion. Frequent dressings expose the wounded part to the chance of movements of the injured tissues, especially where a fracture has occurred. These movements displace the position of tissues and disturb the healing processes. In short, the method is apt to contravene one of the prime necessities for healing, namely *rest* of the injured part.

On the other hand, free incisions to relieve tension and thorough dependent drainage with large masse dressings applied, and fixation of the wounded part with a proper splint properly applied, if the preparation of the wound has been carefully and thoroughly done, permit the wound to remain undisturbed for a week or longer if necessary. I have frequently left these first dressings on for two weeks or longer. This gives the wounded part and the patient himself time to recuperate, and rarely fails to overcome the infection if it be a mixed infection, or only staphylococcal. Gas bacillus infections, as a rule, will not be overcome by either method alone—that is to say, not without further operative procedures.

It is evident therefore that *proper modern treatment* requires the constant collaboration of the pathologist with the surgeon. As soon as it is found that a wound is infected a culture should be made from the pus or serum taken from the inside of the wound and subsequent treatment should be according with the findings of the bacteriologist.

A serious gas bacillus infection cannot be overcome by the use of the Carrel-Dakin treatment alone. If the whole of the wounded area be involved in the infection an amputation, if it be a limb involved, must be performed as soon as practicable. It is now well known that the gas bacilli attack muscular tissue especially, and travel along the inter-muscular spaces. If therefore only one muscle be involved it may be dissected out and removed in its entirety, the intermuscular spaces thoroughly disinfected, and the Carrel-Dakin treatment then employed.

Infections by streptococcus hemolyticus, or even a virulent infection of pure streptococci of a lower strain are also most disastrous occurrences. These, I think, require free incisions to relieve tension, dependent drainage of the freest possible kind, very active general supportive treatment, and antistreptococcal inoculations or vaccinations.

These wounds I prefer to treat with Dichloramine-T. The Dichloramine-T should be inserted into every crick and cranny of the wound by means of saturated gauze wicks and the freest possible dependent drainage must be assured.

4. TREATMENT OF THE CRUSHED PART.—As it was said before, surgeons must not forget that they should consider the whole individual in adopting the measures for treatment of the injury. Further, one must not only consider the immediate condition of the patient but bear in mind also the reconstruction period which will follow, both as regards the ultimate cosmetic effect, and the functional usefulness of the injured member.

The early determination of what operation to do in order to restore the member to something like sightliness, and which will make it of the greatest use to the individual under consideration must be met and the matter definitely settled.

Naturally the question of amputation will be a pressing one in many of the cases. The rules I published some time ago in reference to this determination I still regard as sound and I think I cannot do better than to repeat them here:

"Annular crushes (that is to say, when all the tissues of a limb have been crushed through the whole of a limited transverse section of the limb), require amputation.

"When the soft tissues under the skin as well as the bone have been comminuted by a squeeze or pressure of a car wheel, or heavy machinery, even though the skin may not be badly lacerated, an amputation will be required.

"If the bone or bones of a limb be comminuted beyond a distance of 6 cm. and the soft tissues immediately about the bone be badly lacerated, one should amputate.

"Extensive longitudinal and oblique lacerations admit of conservative treatment as a rule, while circular ones are apt to require amputation.

"Circular lacerations involving the chief bloodvessels and nerves as well as the muscles require amputations.

"In estimating the condition of an injury the extensive muscular lacerations should receive less consideration than great injury to an extensive area of skin.

"Compound fractures which sever a large nerve trunk do not require primary amputation; conservatism should always be tried. The nerve may be sutured and spliced if necessary.

"Compound fractures with injury to one system of bloodvessels when there are two, do not require primary amputations. When both systems of blood-

vessels are torn amputation as a rule, is necessary. Anastomoses of bloodvessels at the site of a badly mangled limb, may, as a rule, not successfully be done.

"When fractures are comminuted as well as compound, injuries to the soft tissues are much more extensive. Areas of thromboses will be much greater and conservatism be less successful.

"In any given case while it is probable that conservative attempts may save a limb but leave it in a useless condition, or in a doubtful state, it would be best to amputate if the amputation would assure a useful stump, unless the injury be high up in the thigh where the mortality rate of amputation is high.

"The individual and his trade or employment should always be taken into consideration in determining whether the probabilities should weigh for or against an amputation

"Doubtful conservative attempts in cases of very seriously crushed limbs have a larger percentage of mortality than amputations have. This fact should also be taken into consideration.

"In all cases of *doubt,* having carefully considered the foregoing facts, one should always delay the amputation. Conservation is always the proper policy when there is a good chance for its success.

"The first sign of gas bacillus or streptococcal infection in these very doubtful delayed cases should determine an amputation immediately, and the open treatment of the stump afterward."

There will be many doubtful cases, however. These I would feel like treating conservatively as long as the principal vessels or a sufficient number of them to nourish the member were left intact and the nerve trunks were not destroyed.

Free incisions to relieve tension and to evacuate effused blood, and thorough dependent drainage should be provided, after careful cleansing and removal of devitalized tissue. An immunizing hypodermatic dose of antitetanic serum should be given and the part put at rest by the application of some well adapted splint.

For years I have been treating crushed extremities after dressing by suspending them from an overhead, or overbed beam.

The experience of the late war has emphasized the value and comfort of this suspension treatment. The "Balkan frame," I think, has come to stay. The swinging of the limb not only enables the nurse and the patient himself to change his position, and to do the offices necessary to keep his bowels in order and his person clean, without much discomfort, but the method enables one to employ traction in any direction necessary with but little friction, and thus adds to the efficiency of traction or directional methods of treatment.

As fractures, compound and comminuted are usually produced by crushing injuries a consideration of what should be done for the fracture is also a most pertinent one. This, however, opens up a big field and it is not the purpose of this paper to discuss the subject of the treatment of compound comminuted fractures. I shall only say it is still my custom to remove all loose and detached fragments of bone and when the condition will permit, to fix the ends of the fractured bone or bones in close and rigid apposition by a plate applied directly to the fragments themslves.

After more than twenty years of experience in the use of the plate in these cases, which as I said are always infected, I am more than ever convinced of the value and safety of the method. *I do not consider an infected wound a contraindication to the use of a bone plate in compound fractures.*

Septic pneumonias are not uncommon complication in these cases. These patients should be treated in a thoroughly ventilated and sunny ward, and not be allowed to remain in the recumbent and fixed position for any length of time. They should be propped up into a sitting or reclining position as soon as possible and be taken into the outdoor air as soon as practicable.

5. RECONSTRUCTION TREATMENT.—The success of any treatment will be determined by (1) saving of the patient's life and (2) returning him to efficiency.

Rehabilitation is the slogan of the period, rightly so, too, for a surgeon, for his work is certainly not complete nor commendable when he goes no further than bringing a patient to the condition when he may be discharged from the hospital.

For this reason all operative procedures and methods of treatment should be dictated by the thought of what will be best for the individual patient in after years.

Plastic surgery has done marvels, and the field is ever widening. Implantations and transplantations of both soft and bony tissues may now be done with confidence of success. These methods of reconstruction should be used when necessary.

Massage and passive movements are valuable aids and should be employed as early as practicable.

The remarkable success of the Willems treatment of injured, even infected joints, has demonstrated the tremendous value of persistent movements of extremities after injuries. Active, voluntary move-

ments are those which especially count. These should be enforced as early as possible.

The bad effect has been demonstrated so often, and the dicta of surgeons who know is so constant against too early weight-bearing after a bone has been badly fractured, it is hardly necessary to do more than again to lay especial stress on the recommendation always to prevent too early weight-bearing, by the use of crutches and some form of splint, or prosthetic apparatus.

Every well equipped hospital should now have a department well provided with apparatus, and under a skilled supervisor for the rehabilitation of injured members and the restitution of functional usefulness.

Industrial surgery has too long neglected this most essential field. The trend of the times and public opinion will, however, soon compel the institution of proper measures for carrying a man from early disability to complete usefulness.

Treatment will not be considered ended until the man in industrial life who has been seriously injured is sent back in a condition to follow his former trade, or *some trade* which will prevent him being a burden on the community.

FEET AND ARCHES.

Tetralogy of Conditions, Ailments and Distortions for Diagnosis Records.

CHARLES CROSS, M.D.,
SAN FRANCISCO.

In response to numerous requests from colleagues for the information and classification in this paper it is presented to call attention to some facts about feet that should be more generally understood. The data from which this information was constructed were gathered over a period of many years as United States Examining Surgeon, and as the Medical Examiner, Consulting Surgeon, and Adjuster for a large number of insurance organizations. As presented in this paper it is the same as taught to Company and Medical Officers by the writer when in recent military service.

This paper suggests a standardization of terms to be used in the examination and diagnosis of ailing feet. To say that a foot is flat, or that an arch is broken may convey one meaning to one person and an entirely different construction may be put upon it by another. On the other hand, to say that an arch presents a distortion of the first degree, second degree, third degree, or fourth degree, accurately describes the condition. The use of the term "degree" is naturally applied to an arc and in this classification it is as descriptive as when the word "degree" is applied in describing a burn.

The great necessity of keeping the feet of both civilians and soldiers in good condition will be passed over as generally conceded. However, it might be well for all members of the profession to remember that the recruiting service of the Army demonstrated that there is in this country a very wide field for the application of special knowledge of the feet.

The first consideration in the study of feet is to understand that there are differences in normal feet. For purposes of accurate description and standardization of the terms applied to normal and ailing feet, the following classification is suggested as a foundation to work upon. It is exceedingly simple, easy to understand and easy to memorize; it saves time and, once understood, it is vividly descriptive.

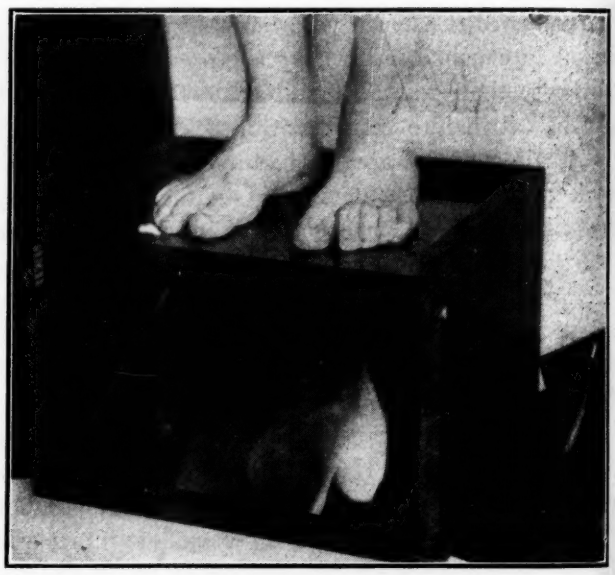

Fig. 1—Normal feet, third degree, on reflector box.

Four degrees of difference in normal feet are described. There is a tetralogy of conditions, ailments, and distortions applicable to the entire subject of feet and it is carried all through this classification.

The equipment necessary to examine feet for purposes of study up to this point consist of 1 table 18" x24" and about 15" high; 1 stool 15" high, 1 pair of dividers, and a one-foot rule. With this equipment every pair of feet you get a chance to look at should be examined and a study made of the general differences in feet.

The degrees of difference in normal feet are determined by the distance of the tuberosity of the scaphoid from the base line stood upon. The tuberosity of the scaphoid is readily located by placing one thumb, pointing towards the toes, below the

inner malleolus, and the other thumb resting against the tip of that thumb, but pointing toward the sole. Rehearsing this procedure a few times will demonstrate the ease and accuracy with which the tubercle of the scaphoid can be located. Under the thumb pointing toward the sole, the tuberosity of the scaphoid is made out by very gentle palpation. After the tuberosity is located the skin over it is marked with a dot, made by a moistened indelible pencil.

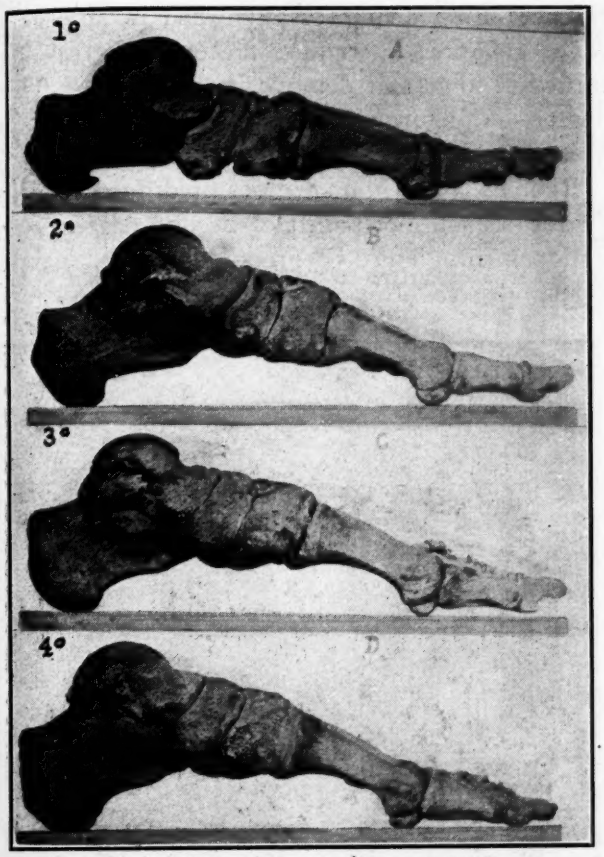

Fig. 2—Normal feet showing four degrees of difference.

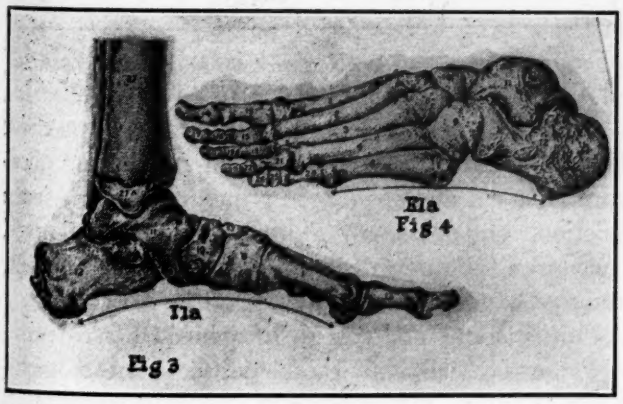

Fig. 3—Internal longitudinal arch (Ila); Fig. 4—External longitudinal arch (Ela).

The measurement is taken as the patient stands erect with body weight equally distributed to both feet. When the location of the tuberosity is marked, a compass or divider is opened, one end resting very lightly against the mark on the skin, the other end resting on the base line stood upon, the distance between the two points of the compass deciding to which degree the foot belongs. (Figure 1).

Normal feet are described in four degrees of difference (figure 2):

1st degree—Tuberosity of scaphoid up to ½ inch above base line.

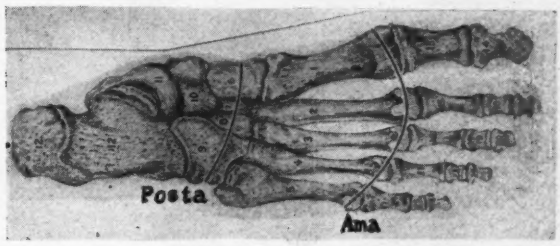

Fig. 5—Anterior metatarsal arch (Ama), and posterior tarsal arch (Posta).

2nd degree—Tuberosity of scaphoid up to 1 inch above base line.

3rd degree—Tuberosity of scaphoid up to 1½ inch above base line.

4th degree—Tuberosity of scaphoid up to 1½ inch above base line.

Four normal arches or curved areas of a foot are described:

1st—Internal longitudinal arch, Fig. 3 (Ila).

Fig. 6—Second degree Ila distortion and luxation middle cuneiforms R. & L.

2nd—External longitudinal arch, Fig. 4 (Ela).

3rd—Anterior metatarsal arch, Fig. 5, A (Ama).

4th—Posterior tarsal arch, Fig. 5, A (Posta).

The "words" in parenthesis represent the first letters in each word and make excellent mnemonic abbreviations for accurate description and rapid record of the conditions presented.

Distorted arches are described in four degrees of difference, and can be readily learned by a careful study of feet and outline tracings.

The terms "broken arch" and "flat foot" are misleading and confusing, and should be applied only to feet that are "flat" or arches that are "broken." Such terms produce decided psychological depression upon patients, especially upon soldiers. It appears more scientific to state the degree to which an arch is distorted as it more correctly describes the actual condition and at the same time indicates the severity of distortion.

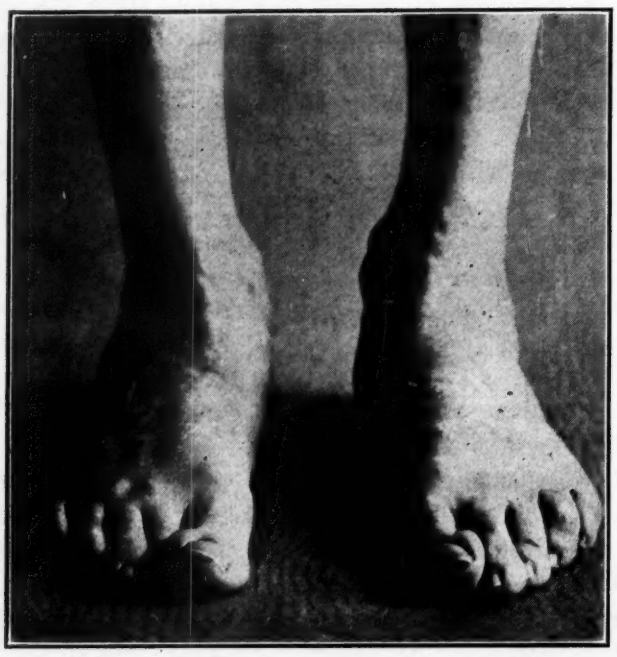

Fig. 7—IIa distortion, fourth degree, rigid.

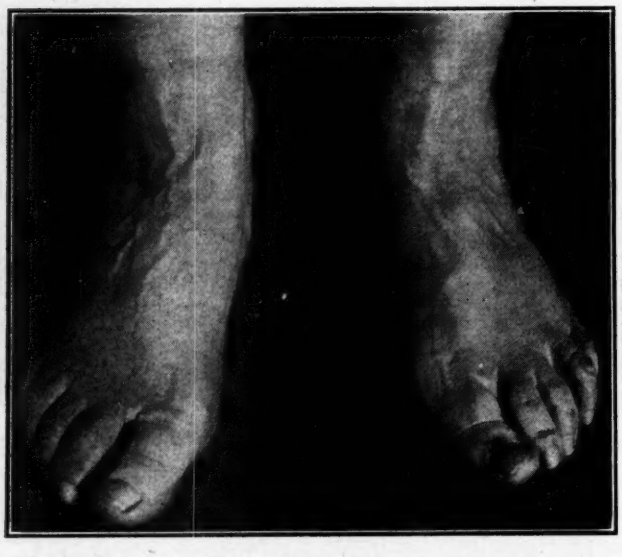

Fig. 8—Swollen, tender, and painful feet from Ama distortion, second degree.

For that reason arch distortions are described as: Distorted longitudinal arch—First degree; distorted longitudinal arch, second degree, (figure 6); distorted longitudinal arch, third degree; distorted longitudinal arch, fourth degree, (figure 7).

The changes which occur to produce each of these conditions can be carefully studied in flexible distorted feet.

Ingrowing toe nail (Ign): Four degrees of difference: First degree—Nail turned in at edge or edges, (figure 7, right). Second degree—Nail turned in to greater depth, (figure 7, left). Third degree—Nail turned in to cause pain. Fourth degree—Nail turned in, inflamed or infected.

Bunions, (B), Four degrees of difference: First degree—Small, not painful. Second degree, large, not painful. Third degree—Any size, painful. Fourth degree—Any size, inflamed.

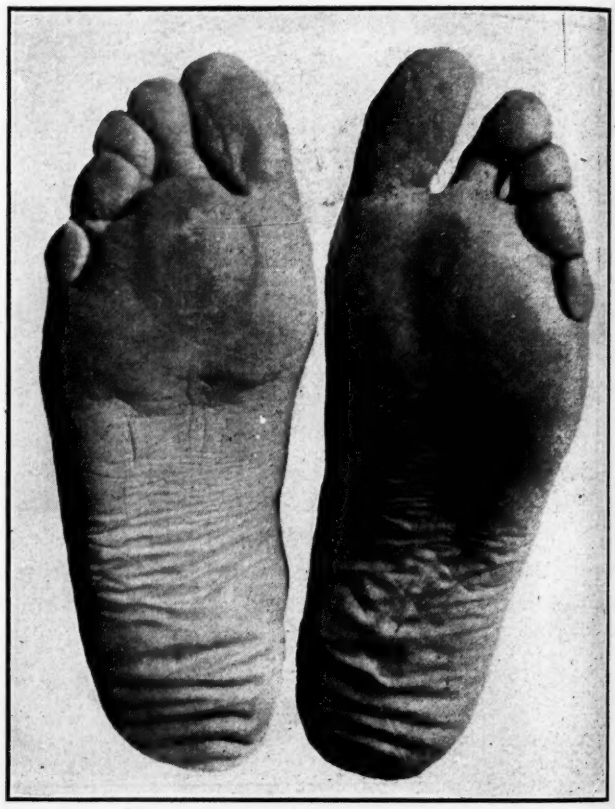

Fig. 9—Right, mass callus and Ama distortion, third degree. Left, discrete callus and Ama distortion, second degree.

Corn (C) Four degrees of difference: First degree—Faint mark on skin from friction or pressure. Second degree—More pronounced mark from friction or pressure. Third degree—Calloused corn area. Fourth degree—Heavy calloused area, commonly called "seed corn." (Fig. 8).

Callus. Four degrees of difference First degree—Protective callus. Second degree—Pathological, discrete callus, under head of distorted metatarsal, (figure 9, right). Third degree—Pathological, mass callus, under head of two or more distorted heads of metatarsals, (figure 9, left). Fourth degree—Inflamed or ulcerated callused areas or calluses complicated with inflamed papillomas.

Papilloma (Pap). Four degrees of difference: First degree—Indicates papilloma is present. Sec-

ond degree—Indicates papilloma is tender. Third degree—Indicates papilloma is painful. Fourth degree—Indicates papilloma is inflamed or ulcerated.

Cramped toes (CT) are decribed in four degrees of difference, depending upon degree of deformity present. (Figure 9).

Toes overriding (TOR) are described in four degrees of difference, depending upon degree to which toes override. Fourth degree represents complete overriding. Expressed in fraction, 4/3-2° indicates that the fouth toe overrides the third toe half way; 3/4-2° indicates that the third toe overrides the fourth toe half way. (9 Rx3/4.) (Left 2/3/4). (Fig. 7). Right 2°, Left 1°.

Club-Nail (CN). Four degrees of difference: First degree—Ordinary small clubbed nail, part of nail normal. Second degree—Thick small clubbed nail. Third degree—Greatly hypertrophied clubbed nail. Fourth degree—Thickened or hypertrophied and inflamed or ulcerated.

Hammer-Toe (HT). Four degrees of difference: The fourth degree representing the most marked degree of hammer toe.

Blister, or Vesicle (V). Four degrees of difference depending upon the size of the vesicle: First degree—Up to ½ inch in diameter. Second degree—Up to 1 inch in diameter. Third degree—Up to 2 inches in diameter. Fourth degree—Up to 3 inches in diameter.

As mentioned above this list forms the foundation for a classification and method of accurate examination and description of feet.

The feet deserve the special consideration of every family physician if we are to have a nation of men and women with good feet to stand upon, to work upon, to play upon, or to fight upon. The feet deserve far more special study than has yet been bestowed upon them. Their ailments constitute a class of time-consuming practice which, as a rule, is not interesting to the operating surgeon. They calling for the application of non-surgical treatment and much time. Many colleagues have come to me after lectures and confessed that they knew little or nothing about the examination, diagnosis and treatment of ailing feet.

It is my desire to spread what information I may have about feet to those who care to make use of it. Some of the methods of examination, diagnosis and treatment are said to be original. In any event they are painless and by their application it is possible to rebuild broken arches in a very large percentage of the cases, so that the feet will sustain the body without the necessity of splints, which often do more harm than good.

THE SO-CALLED INTERSTITIAL GLAND IMPLANTATION. TO WHOM IS THE CREDIT DUE?

G. FRANK LYDSTON, M.D.,
CHICAGO.

Be it understood at the outset, that the term "interstitial glands" is euphemistic and of newspaper-science origin. The glands in question are the reproductive glands. Certain cells in the reproductive glands were termed *glande interstitielle,* by Bouin and Ancel, and "between cells" by Leydig. They are supposed to secrete hormone, or internal secretion, but are not true gland cells.

The notion that certain glands of the body bear a very important relation to its nutrition, and particularly to bodily energy and endurance, is not new. Over three decades ago the venerable Brown-Sequard performed certain experiments upon himself by injecting into his tissues the juices of glands obtained from the lower animals. He reported an extraordinary increase in his vigor and endurance, both mental and physical, and was compelled, willingly or not, to father his so-called "elixir of life," a rather mean advantage to take of one of the world's greatest and most venerable scientists.

In 1849 Berthold, of Göttingen, transplanted the reproductive glands of fowls from their normal location to the abdominal cavity and showed that the normal sex characters of the birds were preserved through the "effect upon the blood." He builded wiser than he knew, for he proved the existence and significance of what we now recognize as an "internal secretion" of probably the most important glands of the body.

As far back as 1899, Forel, in the Italian Biological Archives, claimed that the implantation of a reproductive gland in any part of the body had very profound effects. Since Berthold's day many experimental transplantations and autotransplantations of glands from the living to the living have been performed, with no resulting increase in our knowledge save that such transplantations were practicable.

In 1912 Hammond and Sutton reported a case of sex gland transplantation, the gland being taken from a subject who had just died of hemorrhage from rupture of the liver. This was kept in cold salt solution for some hours, and then transplanted upon a patient who had just had one of his own glands removed for cancer. The object of this transplantation was merely to obtain a psychic effect upon the patient, and no scientific observations were made. Be it remarked, that the transplanted gland in this case, removed from a patient who had just died, was precisely the same as if it had been removed from a living subject under chloroform. Despite the fact that no scientific observations were made or aimed at, this was the first reported case of deliberate transplantation of a human gland, for which America should have due credit. Several other Americans have done work on this or col-

lateral lines for which they have been given due credit in my various writings. My first series of articles in the *New York Medical Journal*, October 17, 24 and 31, and November 7, 1914, contained a bibliography comprising forty-six references, probably all which at that time were worthy of note.

Since the formulation of the theory of internal secretions some years since, an excellent foundation has been afforded for gland work. There has been, of course, almost insuperable difficulty in obtaining glands from the living subject. Noting the work of the late Dr. J. B. Murphy and of Carrel, however, I thought of a way to overcome this difficulty, these experiments having shown, first, that somatic or bodily death did not imply tissue cell death, the cells on the contrary retaining their vitality for a considerable period after the death of the subject, and for a prolonged period if the tissues were frozen. Carrel made many experiments in implantation of glands upon animals which were not brilliantly successful. He did, however, try to formulate a method for the transplantation of new ordinary secretory glands to meet certain indications. but apparently had no thought of the implantation of internal secretory glands for the purpose of obtaining the effects of secretions, which consideration, of course, would have been of no importance in the case of the kidneys, the glands with which his experiments were particularly concerned.

Ever since the publication of Brown Sequard's experiments—then regarded as fantastic—I had entertained more than a suspicion that the venerable Frenchman was not as foolish as some believed. The formulation of the internal secretions theory, and the comparatively recent establishment of their important relations to the welfare of the animal body, convinced me that there was a germ of truth in Séquard's observations and that there was an underlying principle greater than he ever imagined. I therefore determined to conduct some experiments to "prove up." Mindful of the fact that the vitality of the component cells of the various tissues and organs is preserved after bodily death, I determined to experiment with glands taken from a healthy dead body, preserving them by refrigeration as long as might be necessary. I decided to use the reproductive glands with the firm belief that their hormone or internal secretion was the most important in the entire cycle of internal secretory glands, comprising such glands as the thyroid, the pituitary, the suprarenal and others.

With no thought of heroics, and impelled by the obvious practical facts, 1st., that it was hardly fair to subject anyone else to whatever dangers the experiment might involve, and 2d., that if I asked one of my professional friends to perform the operation, I would lose the opportunity of being the pioneer in the field, I resolved to perform the experiment upon myself. This I proceeded to do on January 16, 1914, using material taken from an apparently healthy subject, eighteen years of age, dead seventeen hours. The material was put in a jar of sterile normal salt solution and stood outside of my office window for seven hours prior to the operation. The operation was performed with the assistance of my then associate, Dr. Carl Michel, now in the Public Health Service in San Juan, Porto Rico. Local anesthesia was employed, and a single gland implanted.

On the eighth day the implantation appeared to be a failure, as the wound had not closed completely and there was secretion exuding. I therefore asked Dr. Michel to remove the implanted tissue. To my astonishment the gland split in two, half of it coming away in the forceps, and the other half remaining firmly attached to the tissues in which it was embedded. I was still more astonished to note that the portion removed was unquestionably living and covered with an abundance of new blood vessels, the separation of which from my own tissues produced free breeding. The embedded half of the gland was allowed to remain. It gradually absorbed but did not entirely disappear until about the end of a year, during which time I had abundant opportunities to note the physiological effects.

Since the foregoing operation upon myself I have performed a considerable number of implantations upon both sexes, in all of which I have made careful observations of what I believed to be the effects of the internal secretions of the sex glands upon the human body.

The more important of my conclusions are as follows:

1. Therapeutically successful total or partial implantation of human reproductive glands in both male and female is practicable. So long as a vestige of the implanted gland remains hormone is formed and absorbed, producing effects that endure even after complete absorption has occurred.

2. Glands taken from a healthy dead body at any reasonable time prior to the beginning of decomposition are suitable material and, if implantation succeeds, are of therapeutic value equal to those taken from the living body.

3. The hormone of the glands in question is stimulant, nutrient, tonic and reconstructive, and should be beneficial in many forms of chronic disease.

4. The development of senility can be retarded and longevity probably increased by hormones administered by gland implantation. In one case the previously grey hair upon the arms and breast and the almost entirely grey eye-brows and beard became noticeably darker within a few weeks.

5. Gland implantation is of marked benefit in cases of defective sex development of various kinds.

6. It apparently is valuable in certain obstinate forms of chronic skin disease, notably in psoriasis.

7. It appears to be of great value in arteriosclerosis, when not too far advanced.

8. It thus far has been very effective in anemia.

9. Gland implantation is quite uniformly effective in increasing physiologic efficiency with all the benefits accruing therefrom.

10. Several cases coming under my observation and submitting to gland implantation have had apparently extraordinary results, notably several cases of imperfect sex development with feminine attributes in the male, and in cases where the subject had been rendered thoroughly inefficient in every way as a result of injury or disease.

11. It is not necessary that the implanted gland should remain permanently in order to secure beneficial results.

Referring to the effects of implantation upon the skin, one experimental case of severe extensive psoriasis of long standing, that was dying from a complication of diseases resulting from alcoholism, was very remarkable, the skin disease entirely disappearing within two weeks. The improvement in the condition of the blood in this case was little short of marvellous.

The conclusion at which I finally arrived was that there was nothing miraculous about the effects of gland implantation. The results simply proved the powerful nutritive and stimulant effect of the gland hormone upon every cell of the body, and especially upon the internal secretory issues of every important hormone-producing gland. In brief, it is a "cell food." With myself, gland implantation long since passed the experimental stage.

As to permanency of results, I have a case dating back over five years and several from two to four years, in which the results not only were remarkable, but have been sustained. In at least two of these cases the implanted glands still survive.

In my papers published in the *New York Medical Journal* on the dates already mentioned and later in other medical journals, also in my volume upon the subject of gland implantation, published in 1917, I presented an extensive series of studies and microphotographs of sections taken from glands which had been implanted upon the human body and removed at various intervals. Some of my most remarkable sections and photographs were taken from a male gland taken 30 hours after death, refrigerated for four days and implanted upon the body of an insane female, sixty years of age, the operation being done in the hope that some benefit might be derived from the action of the hormone upon the brain. At the end of four months and nine days, the patient being a bit fussy over the presence of the small tumor formed by the implanted gland in the abdominal wall, the gland was removed under local anesthesia. The microscopic sections plainly showed remnants of secreting tubules, with an abundance of new bloodvessels, and an abundant proliferation of the hormone-producing interstitial connective tissue cells or cells of Leydig. This was the first proof that new bloodvessels formed in implanted glands.

I later performed some implantation experiments upon fowls, in one instance implanting a gland from the living male upon the abdominal wall of a pullet from which it was removed at the end of seventy-five days. As in the case just previously mentioned, the sections showed new bloodvessels, with an abundance of normal blood corpuscles, and something which hitherto had not been demonstrated by anyone, and, so far as I know, has not since been demonstrated, a beautiful and definite picture of the hormone-producing interstitial cells, a microphotograph of which appears in my treatise already mentioned. Some of my sections showed that new bloodvessels containing normal blood were formed by the eighth day after the implantation of the refrigerated organ taken from a dead body. The book contains a series of 25 microphotographs of sections taken from glands which had been implanted and removed, and six photographs of the gross specimen already alluded to, removed four months and nine days after implantation. If there are extant any other illustrations of this kind, I do not know of them, and any which may now exist certainly have been made since mine were published.

Apropos of the recent discussion regarding the merits of the claims of Voronoff, of Paris, that he is the discoverer of the work herein described, the widespread publication of which claim necessitated the writing of this article, I wish to observe:

1. Voronoff's name does not appear in the practically complete bibliography on gland implantation which I published in 1914, which bibliography included every bit of work bearing, even collaterally, upon my experiments that I could find.

2. I never heard the gentleman's name until it appeared in the public press of this country, and am not aware that he has at any time published any observations upon gland implantation in a dignified manner in the medical press.

3. It is a self-evident proposition that Dr. Voronoff is more mindful of the publication of scientific matters in the secular press than he is of such matters appearing through professional channels. He was especially quick to note in the public press that Dr. L. L. Stanley, of San Quentin prison, California, had performed ten gland implantations. Voronoff showed lively interest in this work, by sending a cablegram to Dr. Stanley, congratulating him upon his success with his (sic) (Voronoff's) method. As Dr. Stanley promptly replied through the medium of the *United Press* to the effect that the method which he was using was that of Dr. Lydston, of Chicago, who had performed the operation nearly six years ago, it would seem that Voronoff's congratulations fell rather flat.

As I write, I have before me a telegram received from Dr. Stanley, October 19, 1919, in which he states as follows:

"My ten cases of gland transplantation were done according to your technic, and after close study of your book and reports in the *Journal of the American Medical Association.* No originality was claimed by me. In my only interview to the San Francisco Bulletin, Tuesday, and in interviews of my assistant, full credit was given you. I pointed out that Voronoff was far behind the times and that you had long preceded him. With my permission you reported my first case. I suggest that you give this telegram to the papers."

There also lies before me the official prison records and hospital chart of the first case operated by Dr. Stanley about thirteen months ago, with the correspondence between Dr. Stanley and myself relative to the case. The case was operated upon by my method, and I myself published it, giving Dr. Stanley due credit, in the *Journal of the American Medical Association,* May 31, 1919.

James Thompson, the subject, was a moron,

under sentence from one to seven years for burglary. He was twenty-four years of age, mentally defective and physically inefficient. Glands taken from a subject just hanged for murder were planted upon Thompson with results which, according to the reports received by me from Dr. Stanley at various periods following the operation, were very remarkable, to say the least. At last accounts Thompson was so far improved that he was sent to a roadmaking camp something like two hundred miles away from the penitentiary.

Noting Voronoff's sensational newspaper contributions, one of two conclusions is inevitable, namely, that he either does not read scientific publications, and therefore knows nothing of the literature of the subject in which he is posing as a pioneer, or he gives no credit to the workers in science who have preceded him along similar or collateral lines.

Announcement of my experiments appeared in the *Bulletin of the Chicago Medical Society,* March 7, 1914. At various times within the last few years articles by me upon the subject have appeared in the *Journal of the American Medical Association,* with which publication every well read medical man in Europe in familiar.

Incidentally, if Dr. Voronoff had kept more thoroughly in touch with the scientific literature, he would have found that he was merely burrowing at the foundations of a scientific structure which already was built. The end and aim of animal experimentation is to lead to experimentations or clinical work upon the human subject. As the work upon the human subject already had been done, the gentleman's observations upon the senile goat would seem to be supererogation.

If my distinguished French confrére would read scientific literature with half the zeal with which he reads the secular press, it might help matters some.

Taking their cue from the reports made to scientific societies and from regular scientific channels, the newspapers of this country in March, 1914, gave a pretty thorough presentation of the at that time startling surgical novelty of gland implantation as presented by me to my medical brethren.

We perhaps can forgive Dr. Voronoff for not keeping in touch with the secular press of America six years ago as closely as he evidently does at the present time, but can we forgive him for not reading the public press of Paris? An entire column was devoted to my work in *Le Matin,* Paris, March 23, 1914. It was similarly noted in *Le Gaulois,* Paris, March 25, 1914, and in several other Parisian papers. It also appeared in the *Journal de Rouen,* France, March 24, 1914.

That there was no lack of opportunity for Voronoff to have become acquainted with what was doing in the field of gland implantation in America through European scientific channels, is shown by the following bits of correspondence which lie before me, namely, acknowledgments of the receipt of my work upon gland implantation: From the Rector of the University of Bologna, July, 1918; from the Chief of the Military Medical Service, of France, July, 1918; from the Director of the General Military Medical Service of Rome, Italy, September, 1918; from the Director of the Hospice de la Salpétriére, Paris, July, 1918; from the Secretary of the Royal University of Turin, Italy, July, 1918; from the Director of the University of Madrid, July, 1918.

Just a brief quotation from the article in *Le Gaulois,* already alluded to: "America, the country of audacious surgical experiments, gives us some hope for a cure of the insane. It is Dr. G. Frank Lydston, of Chicago, who is the author of the promising discovery. Assisted by one of his colleagues, Dr. Leininger, he recently grafted into insane persons glands taken from cadavers. He writes of the action of the secretions of these glands after their transplantation, etc., etc."

I have in my possession under the date of June 10, 1918, the acknowledgment of the receipt by *Paris Medical* of an article written in French by my friend, Dr. Luria, of Chicago, containing a report of three of my early cases. In this acknowledgment the editor agrees to publish the article. Whether he has thus far done so, I cannot say. It would be interesting to learn what connection, if any, there is between Voronoff's remarkable newspaper exploits and the fact that a French translation of a report my work was sent to *Paris Medical* in care of the Faculté de Medicin, and was received by that journal seventeen months before.

Had Dr. Voronoff followed the literature carefully, he might have saved himself the trouble of the rejuvenation of the old goat, as he would have found in my work the report of an experiment on a capon, three years old, which was remarkably restored by gland implantation.

As to experimental transplants from the lower animals to man, if he had followed the work of Dr. Robert T. Morris, of New York, he would have found that a decade or so ago, work of that kind had been done in America.

As to Voronoff's suggestion that the bodies of accident victims should be made available to the profession, and that hospitals should be built in popular centers, to which the dead victims of railroad or street accidents can be brought immediately after the accident in order that glands may be gathered and cold-storaged for the purpose of implantation, certain of my conclusions published in 1914 form rather interesting reading. For example: "Opportunities should be sought in the human subject for histologic study of implanted glands at varying periods after implantation, to determine in what degree both generative and internal secretion gland tissues endure. Every effort should be made to so amend our laws that viable tissues of all kinds, notably internal secretory glands, shall become available to science. Legislation and public sentiment should favor scientific research. Between the antivivisectionists, on the one hand, and popular reverence for the dead human body, on the other, we are in sore straits. Why should there be a waste of material which, if properly used, possibly might add so much to the health, happiness, efficiency, and even to the longevity of the human race?"

FURTHER OBSERVATIONS ON A NEW METHOD FOR THE IMMEDIATE STERILIZATION AND CLOSURE OF CHRONIC INFECTED WOUNDS OF BONES AND SOFT TISSUES*

W. Wayne Babcock, M.D.,
Philadelphia.

In June, 1918, we reported 64 cases of chronic osteomyelitis treated at U. S. General Hospital No. 6, Fort McPherson, Atlanta, Ga., by a method of immediate disinfection and closure. Sufficient time has not yet elapsed to fully determine the efficiency of the method and certain dangers and technical details were not understood. Of chief importance is the mortality of the procedure. In our series of 64 cases, one sudden death occurred on the operating table; and in the hands of our associates two additional deaths occurred in which there was a question as to whether the fatalities were due to the anesthetic, or to the treatment used. At the U. S. General Hospital at Fox Hills, Staten Island, three deaths occurred in 29 operations, for one of which, at least, the procedure seemed to be responsible. From two of the bodies of these patients small quantities of zinc were recovered from the viscera, suggesting metallic poisoning; but a control examination of the liver of a patient who had died of empyema and had not had the treatment, showed traces of zinc, confirming other evidence that this metal in minute quantities is a common ingredient of the human body. While the autopsy did not, therefore, reveal the cause of death, clearer light was shed on the subject by a few animal experiments. The injection of less than a drop of a saturated solution of zinc chloride into the marginal ear vein of a rabbit was found to produce almost instant death. If, however, the base of the ear was compressed by the fingers, so as to interrupt the venous circulation during and for two minutes after the injection, no apparent harm resulted. Likewise the injection of three minims of a saturated solution of zinc chloride into the saphenous vein of a dog produced no symptoms, provided the chemical was prevented from immediately entering the general circulation by the temporary application of a tourniquet. By slowly injecting intravenously in dilute solution quantities of zinc chloride were tolerated without symptoms, which when rapidly injected in concentrated form, quickly killed the animal. By previously mixing the salt with a sufficient quantity of the blood of the animal, the toxic action of the zinc chloride, on intravascular injection, also was largely prevented; probably because the chloride is quickly converted by the blood into a relatively inert and insoluble compound.

We have concluded that the forcible injection of a strong solution of zinc chloride into bony sinuses may lead to the penetration of small bloodvessels and such a sudden entrance of the caustic into the blood stream that the central organs are reached before the chloride can be neutralized, with a result that the patient may develop very serious, or even immediately fatal symptoms. This danger may be avoided by keeping a proximal tourniquet applied during the injection of the zinc chloride solution and for five minutes thereafter. If the sinuses involve parts of the body, such as the pelvis or throat, that cannot well be shut off by a tourniquet, the sinuses should be carefully packed with small pledgets of cotton moistened with the zinc solution, and not forcibly injected. That these precautions are efficient is indicated by further experiences: At Fox Hills, after a temporary abandonment, the method was resumed under the direction of Captain Craigin who reports a total of 80 or 90 cases treated without further accident. At the U. S. General Hospital No. 6, at Fort McPherson, in association with Captain W. L. Thornton, we have now used the method on 250 cases of bone infection without further mortality that could be attributed to the chemical used. In the 250 cases there were two deaths—one, the case previously mentioned, in which under spinal anesthesia the patient suddenly developed respiratory or circulatory failure after the forcible injection of a pelvic sinus with zinc chloride, was, with the greatest difficulty, revived by cardiac massage and other measures, and died two hours later. In this case the evidence pointed to the zinc chloride as the causal factor. In the second case the patient collapsed and died four hours after the operation and was found to have an unsuspected metastatic purulent cerebrospinal meningitis, secondary to the extensive chronic osteomyelitis of the femur.

A second danger lies in the operator's failure to excise all chlorided tissues before closing the wound. Tissue left impregnated with the caustic in close proximity to large bloodvessels may by erosion give rise to very serious secondary hemorrhage.

It is believed that if the precautions indicated are carefully followed, this method of sterilization does not add to the danger of the operation, while it greatly reduces the later morbidity. Further ex-

* Read before the twenty-ninth annual session of the New York and New England Association of Railway Surgeons, held at New York City, October 20, 1919.

perience has emphasized the importance of rest and very careful support and accurate fixation in the after-treatment. In two cases the weakened bone fractured from lack of sufficient support. In the cases of complete fracture, the progress was much better where the fragments were well immobilized. Much of the success of the method, therefore, depends on careful after-treatment, and we are greatly indebted to Lt. Cecil E. Warde for his skill in the post-operative, orthopedic treatment of our cases.

Irrigations or injections into the wound should not be used, and drains as a rule are to be avoided in the after-treatment. The patient should remain in bed the first two weeks, and continuously wet mildly antiseptic dressings should be employed. Dakin's solution we have found harmful in these closed cases. In our experience the method is infinitely superior to the other forms of treatment with which we are familiar. None of the patients had been treated less than seven months before the method was tried, and most of the patients had received months of Carrel-Dakin treatment, and all had had from one to nine previous operations.

We would say that chronic bone sinuses are successfully closed in from 70 to 94 per cent. of the cases, dependent upon the thoroughness of the treatment, the character of the lesion, and the degree of destruction of the adjacent soft tissue. Curiously enough, we found secondary infections from operating on gun-shot fractures that had been completely healed for two months, more troublesome than infections after this method was used to tightly close sinuses of bone frankly suppurating at the time of operation.

The method, which is especially adapted for the treatment of osteomyelitis, septic compound fractures, chronic abscesses and sinuses, consists of four procedures carried out in one operation under anesthesia, as follows:

1. *Immediate chemical sterilization* of all sinuses and wound surfaces by the injection and application of a saturated solution of zinc chloride.

2. *Delineation of infected areas* by the injection of an ethereal solution of methylene blue.

3. *Mass excision of the entire area of infection.*

4. *Wound closure* with the obliteration of all dead spaces.

DETAILS OF TECHNIQUE.

1. *Skin Preparation*: If possible the wound area should be prepared by daily shaving, washing with soap and water, removal of scabs and crusts, and the application of 2 per cent. yellow oxide of mercury ointment for three days preceding the operation.

2. *Wound Sterilization*: On the operating table, the skin is (a) thoroughly scrubbed with "B" solution (Liquor cresolis compound 2, turpentine 10, and gasoline 88 parts). (b) Painted with 3 per cent. tincture of iodine. (c) Sterilized by a saturated chloride of zinc solution, thoroughly injected under pressure into all sinuses and cavities, supplied to all unhealed and granulating surfaces, and rubbed over the scar and skin adjacent to the wound. Five minutes are allowed for the penetration of the zinc solution, and great care is taken that every recess of the wound is reached. As previously indicated the injection should be made only after interrupting the circulation of the part by the use of a tourniquet.

3. *Color Delineation*: The following antiseptic staining solution is then thoroughly applied to all eroded surfaces, and injected under pressure into all cavities and sinuses:

Saturated Alcoholic solution methylene blue	20
Caustic Potash	3
Phenol	5
Ether to make	100

As soon as this solution has evaporated, the exposed granulating surfaces are left blue-black, dry, bloodless on manipulation, and sterile. If a section is made through the sinus, it will be found that the coloring has penetrated to a depth of one to three millimeters. Outside of this is a much wider zone of a vascular, greyish white tissue, that has been sterilized and devitalized by the zinc chloride. (Even sequestra removed from deep bone cavities may produce no growth on culture media.)

4. *Excision of Infected Area*: The entire field is again painted with tincture of iodine, and a very free skin incision made, so planned as to permit later closure and to surround and be well outside of all scars and sinuses, which are to be excised, as nearly as possible, *en bloc*. The instruments are now changed; the skin margins are well separated from the adherent underlying tissues by traction with sharp retractors, and dry towels or gauze clipped in position to protect all skin margins. The incision is then deepened to the bone; the periosteum is freely incised and separated from the bone, retracted, protected by gauze or towels; and, beginning some distance from the disease, with sharp chisels the infected bone is freely excised with the attached overlying skin, scars, and sinuses. Care is taken not to completely divide the bone, and to freely expose healthy marrow cavity well beyond the diseased area.

A blue color remaining indicates that all infected bone has not been excised, and the excision is to be continued. The operator should use very sharp knives, gouge and chisels, and work outside the septic focus rather than with curettes, which tempt one to work from within out. If possible, all soft tissues and bone should be removed to a distance of at least one centimeter external to the blue coloration. The bone incisions are so placed as to leave smooth surfaces with no holes, gutters, cups, or pockets, that will remain as "dead" spaces when the soft tissues are closed; and the incision should leave only well vascularized bone and soft tissues free from bone chips and splinters.

Wound Closure: Care is taken that all chlorided tissue has been excised. The muscles and soft tissues are sufficient freed from the skin and from each other to fit into the bone defects. Bleeding is carefully controlled with the smallest possible amount of plain catgut. Plain catgut sutures are used to unite the deeper tissue layers, and the skin is closed with silkworm gut. Only a dry technique is to be employed. Any excess of zinc chloride may, if necessary, be neutralized by a sterile ten per cent. solution of sodium bicarbonate. This is rarely necessary. Voluminous wet and antiseptic dressings are applied until tissue reaction has subsided. For this purpose we use

Solution C:—

Chloral hydrate	1,
Alcohol (95%)	10,
Glycerine	25,
Sat. sol. boric acid	65.

This is used to moisten the dressings every two to four hours, until all inflammatory reaction has subsided, and healing is complete.

BLOOD PRESSURE IN OPERATIVE SURGERY.

Before every surgical operation, a physical examination should be made including an estimation of the blood pressure.

During operations, blood pressure tests provide an invaluable index to surgical shock, hemorrhage, and anesthetic overdosage.

The sphygmomanometer should be used not only in selected cases but also as a routine measure. In this way we shall become accustomed to normal variations in the blood pressure during operations and be able to detect the signs which indicate vital changes in the patient's condition.

The Fowler position should not be used after an operation until the circulatory condition has been proved to be satisfactory by blood pressure examinations.—ALBERT H. MILLER, in *The Journal of the American Medical Association.*

DECOMPRESSION OF THE SPINAL CORD IN TUBERCULOSIS OF THE SPINAL COLUMN*.

F. C. FLOECKINGER, M.D.,
TAYLOR, TEXAS.

All surgeons agree that in an acute attack of appendicitis, as soon as the diagnosis is made, operation should be performed. This problem has been settled. Is it not a fact, that all of us have seen cases, presenting symptoms of kyphosis or lordosis, or psoas abscesses, ankyloses, and other result of detruction of joints and bones and, worst of all, cases of paresis, either monoplogia or paraplegia?

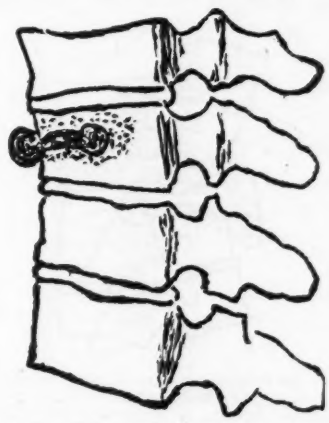

Fig. 1—Tuberculosis of the spine. Primary focus in the body. (After Calot).

Will any one please tell me, if there is an excuse for these poor cripples to have been allowed to reach these states of misery? We are confronted with the same problem as we are in appendicitis. Early diagnosis of the disease can be made if proper diagnostic methods are used, assisted by a careful history of the case. In every case of tuberculosis of the spine the patient or parent will tell us of an injury, that he had a fall three to six weeks before observing the first symptoms, that something was wrong. After the injury, the patient has no symptoms for a certain period, then he complains of pain in the back.

In grown persons this pain is usually called lumbago, which medical term to me is the same as the term "sciatica." In sciatica, which is really neuritis, there must be a cause. The cause may be intraspinal, or along the course of the sciatic nerve or in the nerve itself. Lumbago is usually to be properly termed spondylitis, but it may also be an affection of the sacro-iliac joint. Therefore every case which comes to us for backache should be analyzed very thoroughly.

In growing children with pain in the back, espe-

*Read before the Williamson County Medical Association, April, 1919.

cially on movements of the spine, the mother will often recognize the sensibility of the child's back while bathing the child. The child will cry, when a certain spot on the spine is touched. Next there will develop rigidity of the spine. The child will assume an attitude of stiffness, trying to limit the motions of the spinal column as much as possible.

When those symptoms are present we may be certain that a destructive tuberculous process is already going on in the body of the vertebra. In tuberculosis of the spine, the initial pathological process always begins in the body and not in the transverse processes. What happens with the body of the affected vertebra? The same thing as happens to any joint in the body affected with tuberculosis. We must not forget that tuberculosis of the joint always primarily involves the epiphysis and the subsynovial membrane. That part of the bone which has the most intensive blood supply will be attacked by the tubercle bacillus. The pathological process beginning in the epiphysis will spread in the cancellated structure of the bone, the destroyed cancellated tissue will give way at the point of least resistance and therefore the consequence will be, that the synovia will become affected. The synovia from the irritation produced will throw out fluid, which will cause swelling of the joint. You may aspirate this fluid again and again vainly trying to find the tubercle bacillus in it. The bacteria are in the subsynovial space. If this pressure is not relieved by repeated aspiration, it will cause the destruction of the synovia and the tuberculous focus will break through, involving the joint and causing complete destruction. Then, and only then, will we be able to find tubercle bacilli in the aspirated synovial fluid.

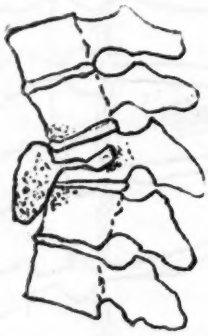

Fig. 2—Progressive disintegration and collapse of the vertebral body. (After Calot).

When the synovia is destroyed, the pathological process spreads to the surrounding loose connective tissue, causing cold abscesses. If the synovia is destroyed, then the joint is absolutely destroyed and ankylosis will be the outcome. Ankylosis will in many cases be the cure of the tuberculosis of the joint. We all know that the tendency to heal a tuberculous process is always towards resolution. Therefore absolute rest is the first principle to adopt for a cure of tuberculosis. In freely movable joints we always treat at first conservatively with immobilization. In tuberculosis of the lungs we similarly immobolize by producing an artificial pneumothorax by injecting nitrogen into the pleural cavity. This fundamental principle has been applied by Hibbs, and later modified by Albee, in curing Pott's disease.

I have been speaking of tuberculosis affecting a freely movable joint. Now in a slightly movable joint such as between the spinal vertebrae, what are the consequences of neglect? We know that tuberculosis belongs to the category of granulomata. The body of the vertebrae, which has more cancellated structure than the arches and transverse processes and a better capillary blood supply is affected. There is no synovia present. The process is limited to the body itself, causing a complete destruction of the osseous structure of the body (figures 1, 2, 3). Sequestration will take place in the body and nature will try to cure the disease by encapsulation. Therefore through the irritating activity of the cells an increased output of osteophytes will take place, which will break through the shell of the body of the vertebrae into the surrounding soft tissue, causing cold abscesses such as psoas abscesses, or it will break through the posterior shell of the vertebrae and encroach on the spinal cord, causing symptoms of compression (figures 4, 5, 6).

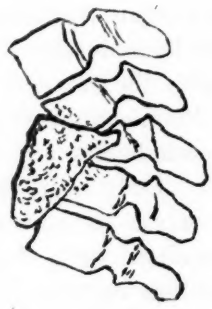

Fig. 3—Spread of infection to contiguous vertebrae. (After Calot).

These cold abscesses, as we call them, should never be incised, no matter where the tuberculous process is active, be it in the pleura, or in the region of a joint. If there is a psoas abscess, aspirate and inject chemicals which have a stimulating effect on the production of leucocytes; iodoform and formaline in glycerine are the two which have most been used. Mosetig-Moorhof of Vienna has used iodoform for many years before our great teacher, John

B. Murphy, began to use formaline in glycerine with splendid success.

Unfortunately most of the cases of tuberculosis of the spine come to us when the process has already so advanced that either kyphosis or lordosis has taken place. If the patient presents a picture of kyphosis we can make a positive statement that the beginning of the tuberculous process was in the fore part of the body of the vertebrae. In lordosis the hind part has been primarily affected. Both those deformities are produced by the superincumbent spine telescoping where resistance is least. Our attitude in those cases is to perform either a Hibbs or an Albee operation, that is, when lordosis or

Fig. 4—The dislodgment of the disintegrated vertebrae and pressure upon the cord. (After Calot).

kyphosis has already taken place. Those operations should never be performed, if a cold abscess is present. The success of these operations depends upon asepsis. We all know that a transplant of bone will not heal, if infection of the wound takes place. Sometimes slight infection of the wound will not interfere with the healing of the transplant, but usually the results will be bad.

If the tuberculous process is permitted to progress for some time, then in some cases the patient will present a typical picture of paresis. All such cases will show kyphosis or lordosis and therefore the differential diagnosis should not be difficult. The extent of the paralysis will depend entirely on the location of the tuberculous focus and on the extent of pressure exerted on the spinal cord. The prognosis in all these cases depends entirely on the amount of pressure exerted on the spinal cord and on the length of time this pressure was active. If the compression is in a direction there the cord will be unable to overcome its effect, then the result will be a permanent injury, instead of dealing with a suspension of the functions of the cord we have then to deal with degeneration.

We all know that the essential elements in a nerve fiber are the axis cylinder process, the medullary sheath and the neurilemma. The axis cylinder process function is to transmit nervous impulses. The medullary sheath is the insulating layer and the neurilemma is the regenerative structure. All peripheral nerves have a neurilemma and therefore will regenerate, but nerves of special sense and the nerve cells of the brain and spinal cord have no neurilemma. Therefore if compression has caused destruction of those nerve fibers, regeneration is out of the question. There is an exception in the nerve cells in the spinal cord and this is the cauda equina.

The first question is the diagnosis. This should not be difficult at all. The *x*-ray plates will show us very clearly, whether we have to deal with an in-

Fig. 5—The escape of an ichor pocket into the epidural space and compression of the cord between it and the neural arch. (After Calot).

flammatory condition, or with tumor formation, such as sarcoma of the vertebrae, or if we have to deal with a fracture-dislocation. A kyphosis due to fracture-dislocation is never painful after the acute period has past, and the onset of symptoms of compression is not as gradual as in tuberculosis. Degeneration of the spinal neuron will take place much more rapidly and degeneration of muscle fibers will be the result, if the nerve supply to the muscle cell is cut off. Therefore in most of the cases of tuberculosis of the spine with pressure symptoms, atrophy of the muscles paralyzed has not taken place. And on this phenomenon depends the prognosis of the case. If atrophy of the muscle has taken place the prognosis is bad.

Another point worth while in differential diagnosis is, that the paresis, as we may call it, is always of a spastic nature. In spastic paralysis, there is an affection of the cord itself and not a lesion of the extra-cranial or extra-spinal nerve fibers. Paralysis of the peripheral nerves, *e. g.*, the brachial plexus, is never spastic, but flaccid.

The sensory disturbances are dependent entirely upon the extent of compression of the cord. Very often the epicritic reflexes, which refer to the skin, are not involved at all and the same is true of the protopathic reflexes.

Trophic disturbances are often met, depending upon the extent of compression of the cord. The anterior horns, with the motor cells, are naturally earlier affected than the posterior, which are concerned in sensation. What shall we do for such cases?

What is the operation of choice in preventing complete destruction of the spinal cord? Common sense will teach us that there is only one operation which will alleviate this condition and this is simple laminectomy or decompression of the cord. All we have to do is to relieve pressure on the cord and if only suspension of the functions has taken place, the patient will get well after the operation, provided other means of assistance are given. In the first place, do nothing more than a simple de-

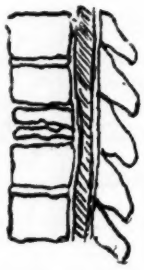

Fig. 6—Pachymeningitis caused by extension of infection from the subjacent osseous lesion. (After Calot)

compression, which in itself is a simple operation. In former years, when radical work was prevalent, Sir Victor Horsley used to decompress, then open into the granuloma and scoop it out. Today we do not need to undertake this step. The administration of tuberculin will take care of the granuloma and the patient will get well. Never drain these cases. If in the process of decompression we do open into the granuloma and the débris shows itself in the field, it should be carefully scooped out, the wound dried, mopped out with lysol or phenol solution, and dried again and sprinkled with powdered iodoform. Then close the wound by taking a strip of the erector spinal muscle and cover the cord with this flap.

Close the fascia and insert figure of eight sutures obliterating all dead spaces. Apply a plaster jacket and begin tuberculin treatment. The outcome will be gratifying to you and to the patient.

The question will come up whether removing the spinous process and part of the arches will interfere with the strength of the spinal column. It has been proven that the removal of the spinous process and the arches of the vertebrae will not materially affect the strength of the spinal column.

The administration of tuberculin in tuberculosis of the spinal column has given the most promising results and never should be neglected. The tuberculin in proper doses can be given by the family physician but he must not push its administration. If he does, he will have a complete failure. Tuberculin should never be given oftener than once a week and the fluctuation in the daily temperature should be a guide to the opsonic index.

The prognosis after this operation of decompression in tuberculosis of the spine is good, provided degeneration of the nerve fibers of the spinal cord has not taken place. After the operation of decompression the surgeon must not expect that the patient will be able to get out of bed and walk in a week. Improvement will be gradual and it may be many months before the patient will be able to walk. Therefore be very conservative in your prognosis as a matter of self-protection.

The following case, referred to me by Dr. Flinn of Hutto, Texas, presented a typical picture of negnected tuberculosis of the spine:

MISS A. D., age 14 years. Former history unimportant. Present history: Three years after a fall, seven years ago, there appeared a boil on the back and from that time curvature of the spine developed. Six weeks ago there began numbness in the lower limbs followed by loss of motion. There is sensation to touch and slight strength to extend the knees, but no active flexion is possible there. Spastic paralysis. Babinski phenomenon and increased ankle clonus present. Exaggerated patellar reflex. Cannot cross the legs. Cannot flex the thighs nor raise herself from lying position. Skiagram shows: marked kyphosis at level of 12th dorsal; destruction of body of 12th dorsal and partial destruction of bodies of 11th dorsal and 1st lumbar vertebrae.

Operation: Decompression of cord with flap closure from erector spinal muscle.

Outcome: Primary union. Tuberculine started 10 days after operation. Marked reaction. Improvement. In two months patient was able to walk without any help. Later lost track of case.

CORNER KIMBRO AND 6TH STREETS.

EXOPHTHALMIC GOITER.

It cannot be denied that certain patients improve and apparently recover under medical treatment. However, in the beginning of the disease it is impossible to distinguish between the patients who may fall in this group and those who are destined to suffer severe damage as the disease progresses. Great responsibility is assumed, therefore, by advising medical treatment in early cases, in which thyroidectomy might prevent the severe conditions and in many instances the death of patients who would fail to improve under medical treatment.—W. E. SISTRUNK in the *Journal of the A. M. A.*

OPEN TREATMENT OF FRACTURES.

ISAAC A. ARNOLD, M.D.,
LOUISVILLE, KY.

Great advance has been made in the treatment of fractures during the past ten or twelve years; especially is this true of the open method. Fifteen years ago the opening of a simple fracture was almost unknown, but today most surgeons have little hesitancy about performing open operation where function and apposition are faulty. Credit is due Mr. Lane for the progressive development in aseptic methods and perfect operative technique in bone surgery. Since Lane's initiative work much has been accomplished by such men as Geiger, Albee, Hibbs, Murphy, and others.

I would like to have it understood at the outset that I do not approve of indiscriminate operating on simple fractures where good apposition and function can be secured by the closed method. I desire it equally understood that any over-riding, displacement of fragments, shortening or malposition should be corrected by the open method if it cannot be accomplished otherwise.

We have learned much from the war just ended about the treatment of fractures, and the time has passed when good results and satisfactory function can be claimed with an over-riding fracture and shortening of one-half to one inch. There may apparently be a certain amount of function in the locality of the fracture, but we must consider the disability which arises from displaced bone, shortening or malposition, and the effect this feature may have on bloodvessels, nerves, or a joint, which may not have manifested itself at the time the patient is dismissed. He will probably later either consult you or an orthopedist because of varicose veins, constant pain in some nerve, or "strained" joint, which continually annoys him. Such lesions were formerly called neuritis, "rheumatism," etc., but with the advancement in bone surgery, and with the valuable aid of the *x*-ray, we are now oftentimes able to relieve obscure cases of "rheumatism," neuritis, etc., by locating and correcting bony malposition, which in former days would have been considered good apposition and function. I believe all fractures of the femur with imperfect anatomic apposition should be corrected by open operation.

On what class of fractures should we use the open method?

(1) Where there is considerable displacement of fragments that cannot be otherwise corrected:
(2) Where complete reduction cannot be secured by manipulation:
(3) Where manipulation causes undue trauma to other structures:
(4) Where there are spiculæ of loose bone or soft tissue between the fragments:
(5) Where the fragments are rotated upon each other and cannot be maintained in proper position:
(6) In spiral and multiple fractures:
(7) Where fractures involve either nerves or bloodvessels:
(8) In ununited fractures and in vicious union:
(9) In fractures complicated by dislocation and in close proximity to joints:
(10) In all fractures of the femur not in perfect anatomic apposition.

In all the lesions mentioned the results will be far better by open operation than by trying to reduce and maintain the fragments by manipulation and external fixation, provided the surgeon is experienced in bone work, has modern instruments for the purpose, and his surroundings are such that perfect asepsis can be secured.

The operative technique of intra-articular fractures is very difficult and should not be undertaken by one who has not had considerable experience in bone work. As Geiger (quoting Hitzrot) has well said, the most striking contraindications for operation on broken bones are inexperience on part of the surgeon, unsuitable surroundings, and insufficient equipment; furthermore, the operator to be successful must have a thorough knowledge of the anatomy of the region to be operated upon, and should understand the action and function of the muscles and ligaments involved in the injured member. Such knowledge may prevent some of the most noticeable failures in the treatment of broken bones.

Excellent results can often be secured by non-operative methods by a surgeon with mechanical skill and experience. The reduction of fractures should always be checked by the *x*-ray to determine whether or not the fragments are in perfect apposition, as that is the only positive way this feature can be determined. At the same time it should be borne in mind that the *x*-ray often seems to exaggerate the deformity if one is unfamiliar with the angle at which the picture was taken.

Why should we operate? First, the greater percentage of cases in which satisfactory function is secured is in favor of open operation considering all classes of fractures. In special fractures, such as both bones of the forearm and the femur, the open operation should always be performed if the position is faulty, furthermore, open operation is more

favorable as age advances. Second, perfect anatomic apposition, hence better cosmetic results; and to be certain of good function, be sure of correct anatomic apposition. Third, union is earlier following the open method, that is where bone grafts are used, but prolonged when foreign material is employed.

When should we operate? In non-infected fractures operation should be performed with the least possible delay after receipt of the injury, *i.e.*, within five or six hours. This is the most favorable time for operation provided too much trauma has not been inflicted by attempted reduction by the closed method. Therefore, *x*-ray examination is absolutely essential to determine the type and position of the fracture, and the advisability of operation before the tissues have been traumatized. The best results by either operative or non-operative methods are secured where the least amount of trauma has been inflicted. If a patient with fracture is seen after twenty-four hours, and there is evidence of considerable damage to the surrounding soft parts produced either by the initial injury or attempted reduction, I would advise waiting ten or fifteen days, or until the tissues have resumed a more normal condition, before operating.

As to material to be used in bone grafting: I would employ only autogenous grafts and metal fixation. In non-infected cases where the anatomy of the part injured does not require too much strain at the site of fracture, the bone graft is preferable. Personally I prefer the inlay or sliding graft to the intermedullary where conditions will permit.

THE TECHNIQUE OF BONE GRAFTING.—It is scarcely necessary for me to emphasize the importance of strict asepsis, as that is one of the fundamental points in successful bone grafting. Certain mechanical and physiological principles must be followed regardless of what material may be used, whether the intermedullary, a transplant from the tibia, the rib, or a sliding graft. In making the incision keep constantly in mind the anatomy of the important structures. Proceed gently and accurately and with as little trauma as possible. After reaching the bone at the site of fracture, careful examination should be made with proper instruments (not the hands) to determine whether an inlay, a medullary or a sliding graft is most appropriate. If an inlay or sliding graft be used, cut the piece of bone or graft so it will fit snugly into the groove made to receive it. This bone should include periosteum, compact bone and endosteum, and should be placed in position so that intimate contact is secured between periosteum and periosteum, compact bone and compact bone, endosteum and endosteum, and be retained by autogenous bone pegs or kangaroo tendon to insure perfect apposition of the graft.

In cutting the graft I prefer a single saw. If a twin saw is used the graft will be the width between the saws, smaller than the groove to receive it, thereby improper apposition and imperfect union may be expected. Likewise it is important that the graft shall not fit too tightly, as pressure may produce necrosis of the bone cells and thus retard union.

Another important feature toward retaining the life of the graft is that the motor should be at such a rate of speed that the heat will not destroy the bone cells. It is inadvisable to have water flowing over the saw to cool it, as this washes away material that is desired should remain in contact with the bone.

If an intermedullary graft or dowel is used, all periosteum must be removed from that part which extends into the canal of the bone; if there is any space or loss of substance from the ends of the fragments, the periosteum should be left on the graft in that space. The dowel should be cut to fit snugly into the canal of the bone. All ivory-like bone should be removed from the canal so the dowel will come into contact with the healthy bone and marrow. Perfect hemostasis must be maintained in this method as well as in the inlay, as a blood clot may separate the soft structures from the bone and the graft will in consequence be poorly nourished.

If a rib or bone from any other part of the body be used, the same principles must be observed, bearing in mind the essential element of a transplant is the cortical bone because of its resistance to change, its small vascular supply, its power to live on a small amount of nourishment, and its active osteogenetic properties which cause it to grow with rapidity and firmness.

The principles just enumerated are the fundamentals in all bone grafting. However, variation in technique and material may be necessary in special fractures. For example, bone pegs are used in fractures of the anatomical neck of the humerus.

As to fixation: It must be borne in mind that bone grafts or pegs are for the purpose of promoting union and to maintain the fragments in direct apposition and continuity—not for strength. Therefore, it is essential that the part grafted be handled carefully and completely immobilized in a plaster of paris cast,—including one or more joints above and below the graft.

As to internal fixation by metal, such as wiring, nailing and plating: Plates should be used in preference to grafts in the presence of infection, where there is great strain on the bone at the site of fracture, and in some of the larger bones when time is important, as one can plate a bone much quicker than a graft can be inserted. In plating a simple, non-infected fracture, the technique is somewhat different from that of infected fractures. In a simple fracture one must use the same precautions as to asepsis as in grafting, and the same care as to handling of the tissues. Make a free incision to the periosteum, but do not disturb it; if from the injury the periosteum has been torn or stripped from the bone, it should be replaced. It is essential that no part of the lacerated periosteum be allowed to extend into the soft structures, as it has osteogenetic power at the osteo-periosteal angle when osteoblasts are attached; hence exuberant callus formation with traumatic exostosis may be expected as the logical result. This is serious when near a joint, as it will cause limited motion; it may involve important nerves and bloodvessels. I have seen this happen in several cases where the musculaspiral and sciatic nerves were implicated. The callus is also troublesome when deposited in the muscles, producing severe pain and limited motion until the callus is absorbed or removed. This is equally important in bone grafting as in plating.

Before the plate is applied see that the ends of the bone are free from foreign material, such as blood clot, bony spiculæ and soft tissue. Also curette the canal until healthy bone marrow is reached. Be conservative of bone, do not remove any part where there is no loss of substance, as jagged ends will become dovetailed and thus prevent shortening of the bone. Use a plate as long as the anatomy of the part will permit, leaving out the end screws nearest the line of fracture, as screws placed too close to the fracture will prolong and sometimes prevent union. The plate having been applied, all vessels having been ligated and oozing controlled, close the soft structures snugly by the layer method with absorbable sutures. Either alcohol or a dry dressing is then applied and the limb completely immobilized in a plaster of paris cast. Another point which must not be overlooked is: do not operate with a tourniquet applied, lest an overlooked vessel begin bleeding with resulting hematoma.

Wiring and nailing have a place in the treatment of special fractures, but their field is limited; therefore, I shall not dwell on that phase of the subject.

The plating of bones in the presence of infection unquestionably has a place in surgery, although the indiscriminate plating of infected fractures is justly condemned. After plating a badly infected recent fracture, with the circulation to the area greatly disturbed, not sufficient time having elapsed for collateral circulation to be established through the lacerated and bruised tissues, with vitality of the entire area markedly lowered, one need anticipate nothing more than failure.

When operating upon a compound, infected fracture, the original opening should be sufficiently enlarged to enable further work to be accomplished with ease. All scar tissue should be removed; this is not only the proper thing to do, but relieves tension and thereby makes the operative field more accessible. All sequestra and callus, also any fragments of bone of which there is any doubt about their viability, should be removed. All ivory looking bone must be removed from the ends of the fragments to be plated, leaving a bleeding area beyond the line of demarcation. The canal should be cleansed of all fibrous tissue until healthy bone marrow is reached.

In most instances the fragments will not fit closely enough to obstruct drainage; but if so a drainage opening should be made by use of the chisel. This is important, otherwise osteomyelitis is likely to develop. The plate should be applied in such manner that it will not interfere with coaptation of the soft structures and the bone at the point where first union is expected. Failure to do this will cause destruction of the bony fragments.

In selecting the plate one as long as the anatomy of the part will permit should be used—preferably a six screw plate—not inserting the two screws nearest the fracture line. Apparently this may seem a minor step, but I have seen cases where the bone became necrotic because screws were placed too near the fracture. Partially close the incision, covering as much of the bone as possible without obstructing drainage. Secure complete immobilization with a plaster of paris cast, a "spanner" being embedded in the cast to afford more strength in the region through which daily dressings are to be made. Another point to be remembered is that the large opening in the cast may permit the leg to herniate through this space, thus producing curvature at the site of fracture. This can easily be prevented by using one or two ordinary forearm splints over the space after the dressings are applied.

The plates should be removed as soon as the bones are sufficiently united to prevent displacement of the fragments. This can be done without

an anesthetic and without removing the cast. As a rule within eight to ten weeks union will have become sufficiently solid to permit removing the cast.

In closing I wish to say there are many special fractures and injuries which require special technique. These are points I would like to discuss, but the paper would become too tiresome.

A FURTHER NOTE ON AN OPERATION FOR RADICAL CURE OF FEMORAL HERNIA.

BENJAMIN BRABSON CATES, M.D.,
KNOXVILLE, TENN.

More than ten years ago I had occasion in an emergency (for strangulated femoral hernia with gangrene of the ilium in the sac) to cut through Poupart's ligament, in order to liberate the gangrenous bowel, and to secure ample working space for resection of the necrosed bowel. I closed up the opening in the peritoneum and sewed Poupart's ligament to the pubic portion of the fascia lata.

The result of this method of relieving the strangulation and performing the radical operation for cure of femoral hernia was so good that I felt justified in reporting it in *Surgery, Gynecology and Obstetrics,* October, 1909. The patient, a man, has remained well over ten years without recurrence.

Recently I have seen two other cases of strangulated femoral hernia, both in women (with hernia on right side) in whom the same technic, with slight modification was used.

One of these, a woman aged 21, I operated upon for Dr. W. A. Greer; in the case of the other woman, aged 40, I assisted Dr. H. J. Kelso. Both patients made uneventful recoveries, notwithstanding Dr. Kelso's patient had a profuse hemoptysis just as the operation was started, which upset the doctors and nurses very much. It looked as though the patient would drown in her own blood. Fortunately there was a throat aspirator at hand, which was set going and took out fully a pint of blood. Some aromatic spirits of ammonia was quickly poured into her throat, which stimulated respiration; the operation was then completed as planned. The patient made an uneventful recovery. It seemed strange the patient should have this hemorrhage, as she appeared to be perfectly healthy being, inclined to stoutness, and had never had a chronic cough. Her heart was sound and her lungs were clear. She has had no cough since the operation. In both these cases the sac was large and it was impossible to reduce the bowel until Poupart's ligament was divided.

The technic used in these two cases was the same as I used ten years ago except as to dealing with the sac, as described below: A long incision was made in the skin from the spine of the pubis outwards, below and paralled with Poupart's ligament. Two pairs of Mayo's forceps were thrust in the femoral ring above the neck of the sac for a short distance and the falciform and Poupart's ligaments divided for half an inch; then other forceps were pushed in above the first pair and the tissues divided, using scissors. By sponging back the tissues, and dividing between forceps, one avoids wounding important structures, and if anomalous obturator, or deep epigastric arteries are divided, they are held securely between the forceps, and can be tied at leisure, thus avoiding flooding the field of operation with blood, embarrassing the operator and prolonging the operation. After dividing the ligaments the sacs were opened and the bowels replaced.

After replacing the contents of the sac, the peritoneum was pushed back with gauze for an inch or more above Poupart's ligament. The sac bore the same relation to the general peritoneum as the neck of a gourd does to the body of a gourd. The narrowest part of the sac was then tied with a double strand of No. 2 catgut on a Mayo needle. The redundant part of the sac was then cut away; the remaining part of sac was gathered on the catgut suture and the needle thrust through the entire thickness of the abdominal walls and sewed to the anterior surface of the abdomen, as in the Mac-Ewen operation for inguinal hernia.

This last step of the operation is entirely outside the peritoneal cavity. The operation is completed by sewing the inner end of Poupart's ligament to the pubic portion of the fascia lata with catgut and closing the skin incision with silk-worm-gut sutures without drainage.

508 W. CLINCH STREET.

THE INCIDENCE OF HERNIA.

Data on the physical examination of prospective employees reveal the fact that approximately 3 per cent. of the men offering their services to the industries have well developed inguinal hernias; approximately 14 per cent. have incipient hernias. Hernia occurs with sufficient frequency to be regarded as the greatest single frailty of the American worker. The oblique inguinal type comprises over 92 per cent. of all hernias encountered.—CHARLES A. LAUFFER *in The Journal of Industrial Hygiene.*

American Journal of Surgery

PUBLISHED BY THE

SURGERY PUBLISHING CO.

J. MacDONALD, Jr., M. D., President and Treasurer

15 East 26th St., New York, U. S. A.

to whom all communications intended for the Editor, original articles, books for review, exchanges, business letters and subscriptions should be addressed.

SUBSCRIPTION PRICE, TWO DOLLARS. FOREIGN, TWELVE SHILLINGS.

Original Articles and Clinical Reports are solicited for publication with the understanding that they are contributed exclusively for this journal.

It is of advantage to submit typewritten manuscript; it avoids errors.

CHANGE OF ADDRESS. Subscribers changing their address *should immediately notify us of their present and past locations. We cannot hold ourselves responsible for non-receipt of the Journal in such cases unless we are thus notified.*

ILLUSTRATIONS. Half-tones, line etchings and other illustrations will be furnished by the publishers when photographs or drawings are supplied by the author.

SPECIAL NOTICE TO SUBSCRIBERS

The "American Journal of Surgery" is never sent to any subscriber except upon a definite written order. Present and prospective readers please note this.

WALTER M. BRICKNER, M.D., F.A.C.S., Editor.

NEW YORK, MARCH, 1920.

SURGERY IN EXOPHTHALMIC GOITER.

What are the results of surgery in exophthalmic goiter? How many cases are cured by operation, how many are distinctly improved?

The symptoms of exophthalmic goiter are attributed to hyperthyroidism, to an abnormal activity of the thyroid gland; and so, after practicing and discarding sympathectomy and other futile operations, there developed the procedure of removing more or less of the offending gland as a means of reducing its secretion. If the disease lies wholly within the thyroid, and its symptoms are wholly those of hypersecretion, removal of this organ would seem to be, on its face, a rational procedure. But are the premises sound? Is Basedow's disease an affection of the thyroid alone? Is hyperthyroidism an all-inclusive description of its phenomena? Finally, do the results of thyroidectomy or of polar ligation support the argument?

How much do we know of the pathogenesis of exophthalmic goiter? How much are we yet to learn of the perverted physiology with which it is associated or which it produces? To what extent are the organic and functional disturbances of other organs due to the involvement of the thyroid, to what extent are they the expressions of a disease of which, perhaps, this gland only furnishes the most striking phenomena?

Instances are many of the rapid development of Basedow's disease after other illnesses, more or less severe, and after nervous shocks. Indeed, it seems not unlikely that the nervous system plays a large rôle in the etiology as well as the sympomatology of exophthalmic goiter. Nor is it rare that all the signs and symptoms of a severe Basedow's disease disappear during treatment by rest and environmental change or, indeed, without any rational treatment.

Surgical literature is replete with contributions concerning the technic of operations for exophthalmic goiter; concerning the ultimate results of operation one finds very little. On the programme of the forthcoming meeting of the American Medical Association are four papers on thyroid surgery —all, apparently, dealing only with the technic, not the ultimate results.

Surgeons are quite familiar with cases in which thyroidectomy has failed to improve exophthalmic goiter and others in which the improvement has been little or transitory; and, too, we know that alarming, often fatal exaggeration of hyperthyroidism sometimes follows immediately upon surgical manipulation of the gland. It is indeed an accomplishment that Crile has been able to obviate or to overcome this by the methods he has evolved. In his address before the Clinical Congress of the American College of Surgeons last October (published in *Surgery, Gynecology and Obstetrics,* January, 1920) he reported that as a result of the system of management he then described he had reduced his mortality from thyroidectomies in exophthalmic goiter to 1.1 per cent.—a series of 182 with but two deaths. But concerning the ultimate results Crile says nothing beyond a passing reference to "striking benefits."

Is it not time that we took stock of these end-results?* Many surgeons are having misgivings concerning the value of surgery in Basedow's disease —perhaps unjustifiably, perhaps because of faulty methods of management or after-treatment, perhaps because of insufficient experience. They want to know whether or not we are on the right track! The internists, too, are in doubt. Some are quite dissatisfied with the results of surgery in Basedow's disease. In the October-December, 1919, issue of *Endocrinology,* Israel Bram, of Philadelphia, says:

"Exophthalmic goiter does not fall into the realm

*Seven years ago C. H. Mayo, reporting 2,295 operations for exophthalmic goiter, said "Operation in cases of hyperthroidism appears to give about 75% of cures, while the remaining 25% are more or less benefited, according to the degree of complication and the stage of the disease. Probably 10% have some degree of relapse in from one to three years after operation."—(*Journal of the A. M. A.,* July 5, 1913.)

of surgery," except . . . . "the secondary or Basedowified goiter, whether causing mechanical symptoms or not. . . . In this latter type the thyrotoxicosis is secondary to the presence of that goiter, be it colloid, cystic, or otherwise, and as soon as the goiter is removed, the toxic symptoms disappear. These cases present the most gratifying surgical results. These conditions, however, are not the true, clear-cut cases of Graves' disease, a condition in which we unreservedly deny the right of surgery to interfere. . . . . .

Statistics are a great source of error in surgery as elsewhere. The gloating over low mortality figures is a very misleading point to far-sighted investigators. . . . Mere improvement is not sufficient reward to the patient for the risk that she has consented to undergo, nor is it sufficient compensation for the scar which she will present throughout life. Improvement is usually short-lived in almost every instance, the status merging back to the full-fledged condition with which the patient formerly suffered. Indeed, occasionally the symptoms will return with greater vehemence than the occurrence of the original attack. . . . .

In the rare instances in which there is no recurrence of the symptoms within a year or two following thyroidectomy, the patient had obtained either (a) a natural cure, i. e., the patient was one of those rare instances which tended toward spontaneous recovery, treatment or no treatment; a case of this sort gets well not because of but in spite of surgical treatment; or (b) a non-surgical cure. Careful surgeons will see that their patients be given prolonged non-surgical treatment prior to operation, and many still more carefully outline non-surgical treatment for a long time after operation is performed, ... the credit of the possible relief or cure of necessity reverting to the non-surgical procedures employed before and after the operation, ... without the religious observance of which, it is frankly admitted by the surgeons, the patient has little hope of the relief of symptoms.

. . . . . .

The real difficulty in the treatment of hyperthyroidism has been that both surgeons and internists have looked for immediate results and drawn their deductions and statistics accordingly. . . . . The truth of the matter is that the surgeon should show less haste, and the internist more patience, in the treatment of these cases. I base this conclusion upon the lack of statistics proving permanent cures in exophthalmic goiter on the part of surgeons, and upon the presence of a large number of permanent cures effected by some internists who skillfully and patiently employ the proper non-surgical procedures through the length of time necessary to bring about complete recovery."

Surgical statistics afford no basis for disputing Bram's contentions. We question, however, whether most internists will agree in his concluding statements:

> "Careful non-surgical management, then, is capable of completely and permanently curing the great majority of cases of hyperthyroidism. The occasional exception not responding to non-surgical measures is not an instance of genuine Graves' disease, but is one of malignant degeneration of the thyroid gland, a case of toxic symptoms superimposed upon a long-standing non-toxic goiter, or a case brought to the clinician's attention in a moribund condition. The writer, in unison with others interested in thyroid therapy, does not hesitate to conclude that he has been able to cure every case of primary Graves' disease in which a fair degree of co-operation was obtainable; this was accomplished in from six months to two years, depending upon the exigencies of the case treated."

If internists generally, or any considerable number of them, could "cure every case of primary Graves' disease in which a fair degree of co-operation was obtainable" they would not have turned to the surgeons for help. The non-surgical treatment is sometimes a distinct failure; and, too, a very large percentage of the cases of exophthalmic goiter is among those who, with the best of intentions, cannot supply the necessary "degree of co-operation," nor submit to the prolonged abstention from household or other work that the treatment often requires.

The fact is that we know too little concerning the processes of the disease to say how it should be treated. Spontaneous recoveries take place "in spite of" medical as well as of surgical treatment. Careful non-surgical management is unquestionably responsible for some cures. Perhaps surgery has a valuable place in the therapy of exophthalmic goiter; perhaps it has none. Let us know the facts from an analysis of end-results and thus clear the way for its further development or for its abandonment in favor of some more rational plan.

AMERICAN MEDICAL EDITORS' ASSOCIATION.

The fifty-first annual meeting of the American Medical Editors' Association will be held at the Grunewald Hotel, New Orleans, La., on Monday and Tuesday, April 26th and 27th (during the week of the A. M. A. Convention), under the Presidency of Dr. Seale Harris, editor of the *Southern Medical Journal.*

ANNOUNCEMENT.

The May issue of THE JOURNAL will be devoted to the surgery of the nose, throat and ear.

Surgical Suggestions

The severe pain of a fresh burn may be relieved by immersing the part in cold water.

The healing of a sluggish wound may sometimes be much accelerated by exposure to sunlight.

Unless the cause of a post-operative rise in temperature is otherwise obvious examine the wound!

The operation of subtemporal decompression will fail of its object if the surgeon removes too small an area of bone.

When amputating an infected finger or toe tie a catgut ligature about the flexor and extensor tendons, including their sheaths, proximal to the level where they are to be divided. This is to prevent infection spreading up in the sheaths.

In children, especially, attacks of acidosis may resemble those of acute appendicitis. Malaria sometimes causes abdominal symptoms that may be mistaken for those of appendicitis or cholelithiasis.

"Chronic appendicitis" without definite attacks is often not appendicitis at all; and a large percentage of people operated upon for "chronic appendicitis" have not been relieved of their pains.

There are two operations in which it is permissible and desirable to use an ungloved hand: in the suprapubic enucleation of the prostate and in the search for a small foreign body—especially a needle fragment—in the muscles.

After thoracotomy for empyema Carrel-Dakin treatment of the cavity breaks up any contained fibrin clots and, if properly carried out, it usually effects early sterilization and healing without the necessity for any secondary operation. Rib resection in thoracotomy for acute empyema is not necessary.

Pneumothorax and collapse of the lung will result if the chest is opened too early, for the evacuation of a developing empyema thoracis. Do not operate until the fluid has become frankly purulent, by which time the collection will be walled off by lung adhesion. Meanwhile care for the patient's general condition and, if necessary, draw off embarrassing fluid by aspiration.

Surgical Sociology

Ira S. Wile, M.D., Department Editor

INDUSTRIAL HYGIENISTS.

Among recent developments in medicine the growth of industrial hygiene stands out with peculiar prominence. For many years the contract employment of physicians to attend injured employees has been recognized as an unsatisfactory method of meeting the surgical problems in industry. All too frequently work of this character was seized upon as a sort of temporary stop-gap to meet the overhead expenses of young physicians with ample time and, unfortunately, inadequate experience.

In large plants the growth and development of first aid facilities under legal mandates gave rise to the improvement of emergency aid; and a gain and benefit was effected through the establishment of operating rooms for minor surgery, and in very large plants, or those with great hazards, through the institution of industrial hospitals on an individual or cooperative basis.

With the spread of Workmen's Compensation legislation and a growth of interest in the "safety first" movement, expansion of industrial surgery followed the lines of prevention, the inauguration of a system of industrial nursing and an increase in plans for more adequate surgical service including dispensary and hospital provisions. Recent developments in the improvement of medical departments in industry have given rise to a broader idea of the value of medical service in industry and have led to the evolution of specialized experts in industrial medicine whose field demands full time service and can be filled only by medical men of considerable experience in general practice, supplemented by a reasonable degree of knowledge of preventive medicine, mental hygiene, the prevention of accidents, and surgical technic.

The qualifications for industrial physicians, however, demand a variety of experience that will enable the medical director to cooperate with public health officials on the one hand, and to serve with equal expertness the employers and the employees in the specific industry over which he presides in a variety of directions. As pointed out by C. E. Ford, in the *Journal of Industrial Hygiene*, December, 1919, the industrial physician must possess some practical working knowledge of the special problems involved in the employment of men, women and children. He must be familiar with systems of pension and insurance, including liability, group, and

social insurance. There must be more than a theoretic acquaintanceship with job analysis, including physical and mental tests necessary to determine the fitness of the applicants. On the educational side, it is essential that he know something concerning industrial training, continuation schools, the possibilities of specific educational development without the industry or in some institution provided at private or public expense.

The relations of accident and disease to hours of labor, monotony of occupation, and speed are sufficiently important to demand an understanding of various phases of industrial application to personal health. This includes, also, a wide grasp of the physical working conditions in the individual plant with general knowledge concerning the hygienic values involved in heating, lighting, ventilation, the value of wash-rooms, restaurants, and rest rooms, water supply, toilet and similar practical factors that determine the healthfulness of industrial environment.

Obviously, a medical director is responsible for the physical examination of employees and the periodic re-examination of employees as well as the personal oversight of those injured or diseased through occupational dangers. This embraces also familiarity with follow-up systems, physical and industrial rehabilitation, including the replacement of the injured and crippled employees, as well as the transfer and replacement of industrial misfits and the adjustment of jobs to the physical and mental potentials of those accepted for service.

To these general capabilities there must be added an ability to mix well with men, to be able to give counsel concerning athletics, social and educational activities, facility in expression and an understanding of the human equations that are to be solved in connection with the industrial difficulties that are wont to arise at the present time. This necessarily includes an ability to grapple with numerous social, economic, educational and industrial difficulties that are as important in industry as operations following accidents, or as the construction, management and supervision of a corporate hospital. The complexity of questions that deal with labor turn-over, wage adjustments, company housing, labor-saving devices, minimum wage disputes, unionization, or the effects of varying costs of living are not foreign topics in the mind of the industrial physician.

It is patent from this brief survey of the requirements of industrial medical directors that the poorly trained, inexperienced, part-time service physician or surgeon is completely unqualified to meet the demands now being made by industry. It, therefore, is not strange that a new field should be opening up that offers large rewards, financial and ethical, for those competent to serve the industry and the community of which it forms a part. Within a comparatively few years many large industries have placed their medical affairs upon a high plane of ideals of service, and growth in this direction is rapidly increasing. This represents another step in the development of the idea that the maintenance of the health, welfare, and happiness of employees is an industrial asset as well as an industrial responsibility. Through the establishment of industrial hygienists as medical directors the public health movement is receiving a new impetus and communal health is achieving a rich benefit.

Progress in Surgery

A Résumé of Recent Literature.

Edward Bleier, M.D., Abstract Editor.

The Treatment of Bone Cavities. WALTON MARTIN, New York. *Annals of Surgery,* January, 1920.

From a study of a large series of cases and long clinical experience, Martin draws the following conclusions in reference to bone cavities:

1. That complete removal of all the infected bone lining the cavity, of all foreign particles, and of every particle of dead bone is essential.
2. That in the great majority of cases, the cavity must be obliterated to insure healing.
3. That this is most satisfactorily accomplished by the removal of sufficient portions of the wall of the cavity to allow the soft parts to fall in and fill it up.
4. That in certain tunnels and cavities near joints some form of plugging may be indicated.
5. That of the many materials used as plugs, the free fat transplants present real advantages.
6. That the two-stage operation, with careful sterilization of the cavity under bacteriological control, following the Carrel-Dakin technic is of great value.
7. That in the small chronic abscesses in the ends of long bonds, with attenuated infection, no filling or intermediate sterilization is necessary.

Pathology and Treatment of Chronic Osteomyelitis in Unhealed War Wounds. ROBERT GOODMAN, Philadelphia. *Therapeutic Gazette,* February, 1920.

The author discusses the pathology of the commoner types of osteomyelitis following gun-shot injuries. In reference to treatment he lays down the following principles:

Do not use gauze drains; they do not drain, but keep up the discharge. It must be remembered that the sinus is not the primary lesion. Sunlight or heliotherapy is beneficial in tuberculosis, but not of any value in osteomyelitis. The only treatment of osteomyelitis is operative, at the proper time. Remove the superficial sequestrum and the cure is rapid if the cavity is small. Deep sequestra make the operation more difficult, with the presence of large cavities; but other methods are useless. The cavity must be obliterated. Spoon curettage of the sinus and cavity is useless; and radical excision is indicated especially in suppurating cavities. The healthy bone which forms the wall of the cavity fills up with a blood-clot, becomes fibrous, then cartilaginous, and then lime salts are deposited. The periosteum sinks into the cavity, and the depression always remains; the periosteum and endosteum forming new bone.

Filling of the cavity with sponges, decalcified bone and

iodoform pastes have been used, but not very successfully. A wide removal of bone, allowing the neighboring soft tissues to come into contact with the remaining bone, is advocated. The cavity and sinus decrease in size gradually. Subsequent scraping is often necessary, because of secondary necrosis.

In cases of absence of a section of bone, regular flushing by the Carrel-Dakin method, until the infection and necrosed bone is eliminated, with subsequent bone transplantation, is successfully used.

Do not remove a joint if it can be avoided; an ankylosed joint is better than a flail one.

Studies in Bone Growth. FRED H. ALBEE and HAROLD F. MORRISON, New York. *Annals of Surgery;* January, 1920.

The experiments were performed upon rabbits, with a view to discovering a reliable stimulant to bone growth. The following conclusions were drawn:

1. Cases of fracture, with loss of substance, showed a much more rapid bone growth, when triple calcium phosphate was injected into the gap between the bone ends, than did the controls without its use.

2. Callus formation in the cases of fracture treated with triple calcium phosphate, extended far into the soft parts, apparently following the penetration of the solution. In some cases the callus even extended out beneath the skin.

3. In the entire series of experiments, the average length of time for union in cases of fracture treated with triple calcium phosphate was thirty-one days. The average length of time for union in the controls was forty-two days.

4. No appreciable bone growth was stimulated by an attempt to inject triple calcium phosphate beneath the periosteum of the radius, when the bone was not fractured. Undoubtedly the solution in such cases infiltrated the soft parts and did not actually come into contact with the bone-growing tissues.

It is evident that osteogenesis was stimulated by triple calcium phosphate in conjunction with fracture, or in other words, with trauma of sufficiently great severity to open up those bone surfaces containing active bone growing cells, namely the periosteum, compact bone, endosteum and marrow, thereby allowing the intimate contact of the solution with these layers.

5. Triple calcium phosphate produce no *x*-ray shadow by itself.

6. No toxic symptoms were noted in any of the cases treated with triple calcium phosphate. At no time did this agent act as an irritant locally.

7. In the animals treated, only one injection of triple calcium phosphate was administered. The suggestion is offered that the stimulating action of this agent might be increased by repeated injections at frequent intervals, in unfavorable clinical cases of pseudarthrosis, whether or not preceded by a bone graft operation.

8. It is believed that these facts are of sufficient value to warrant their clinical application, and the treatment is now being tried on human subjects.

Gunshot Fracture of the Femur. SIR ANTHONY BOWLBY, England. *The British Medical Journal,* January 3, 1920.

Bowlby discusses in detail the management of fractures of the femur at the front, en route and the base hospital. His principals of treatment are outlined in the following paragraphs:

1. The first general principle which was universally adopted was that the apparatus employed should be a skeleton metal splint, and that this should be used so as to enable traction to be applied either directly downwards or else in various degrees of abduction or flexion. This was the essential foundation upon which all else was based.

2. The direction of the traction and the amount of flexion or abduction required were guided throughout by frequent radiograms. These were always taken by a movable *x*-ray apparatus brought to the side of the bed, and by the aid of these the position of the fragments was altered, so as to obtain accurate apposition. Without the frequent use at the bedside of *x*-rays it is not possible to obtain uniformly good results.

3. The length of the limb was at first measured daily and afterwards less frequently, and it was found most useful to keep a "chart of shortening" (or lengthening) over the patient's bed. It became the custom to apply extension until the injured limb was definitely longer than its fellow, as it was found that this gave the best end results. It is most important to bear in mind that even when the main fragments of bone are separated by an interval of as much as one or two inches the gap can be completely filled by new bone.

4. "Fixed" extension proved to be not so good as "continuous" extension. The traction can be employed either by fixing the foot, and then lifting the end of the bed and letting the weight of the patient act as the extending agent, or else by applying weight traction. On the whole, the use of the patient's own body weight was the method most in favor.

5. Movements of the knee-joint were begun early, and slight flexion of the knee was always preferred to traction on the fully extended limb. The early experience of the war had shown us that unless special precautions were taken a permanently partially stiff knee-joint was extremely common. This might be due to (*a*) mild sepsis; (*b*) fracture near the articulation; (*c*) scarring, shrinkage, and adhesion of muscles, tendons, and skin. Captain Watkin Williams devised a very simple metal apparatus, which was attached to the main splint, and enabled the knee to be freely moved or fixed at any angle of flexion. Colonel Besley, of the Chicago unit, gave great help by the callipers which he devised. These were fixed above the condyles of the femur, and were especially valuable for cases of fracture of the lower third of the femur, for their use completely overcame the flexion so common in these cases, and they also enabled the knee joint to be freely moved without disturbing the traction on the femur. Many surgeons employed "calliper extension" for all their cases. It should be noted that if callipers are employed the following precautions are necessary: (*a*) rigorous asepsis; (*b*) avoidance of the synovial membrane; (*c*) avoidance of the thin articular bone of the condyles by fixing the callipers on the denser bone at the level of the adductor tubercle; (*d*) the use of any simple method for preventing the too deep penetration of the bone by the points of the callipers.

6. For fractures about the upper third and the neck the patient was placed either upon the hammock-like swing cradle invented and described by Major Sinclair, or else upon the special segmented mattress designed by Major Pearson. This latter was adopted late in 1918 by the Army Medical Department for the treatment of all cases of fracture of the femur under treatment in England, and has been fully figured and described by Major Pearson in his book *Fractured Femurs* (Pearson and Drummond, 1919).

7. When union was sufficiently advanced it was the custom to get patients out of bed while maintaining the length of the limb by the application of "walking calliper splints" fixed to the heel of the boot. If these were employed the use of the limb accelerated the formation of callus, but if they were not provided many limbs yielded and became bowed in attempts to walk.

8. The treatment of the wounds was on general principles, but in the year 1918 very great benefit resulted from early "delayed primary suture" or from "secondary suture." Cases so treated showed a more rapid union of the fracture and a great shortening of the period of pyrexia. They also were much less liable to late necrosis of fragments and to secondary abscess. The natural result was a decreased mortality in sutured cases as compared to those unsutured and a great diminution in the amputation rate. In cases which could not be sutured the period of suppuration was often shortened by the employment of Carrel's methods.

9. The question of the removal of bone was not entirely settled when the war ended. There was no doubt of the advisability of removing badly smashed fragments which had been completely separated. But, while most surgeons did not advocate the removal of more than this, some operators followed the advice of Leriche and prac-

ticed subperiosteal removal of many of the partially detached fragments also. There seems no doubt that, on the one hand, the removal of all fragments which might necrose hastens the healing of the wound, whilst, on the other hand, this removal delays the union of the fracture, and, in the opinion of some very competent observers, has been responsible for permanent non-union in not a few instances.

The Anatomy of Snapping Hip. F. WOOD JONES, London. *The Journal of Orthopedic Surgery*, January, 1920.

By operation on two cases in the military service Jones was able to determine the cause of so-called "snapping hip." The symptom is usually elicited on rotation from the extreme internal position to the position of extreme external rotation. Roentgenography and examination under anesthesia revealed nothing. On the operating table it was impossible by manipulation of the leg to reproduce the snap made during life, nor was any structure capable of causing the condition obvious from examination. The gluteus maximus was, therefore, electrically stimulated and while it was in a state of active contraction the leg was again manipulated. The snap was now elicited every time the great trochanter was rotated backwards or forwards between the gluteus maximus. Upon dividing the fascial insertion of the muscle and reflecting it towards the middle line it was at once apparent that the structure which infringed on the trochanter and caused the snap was the tendon developed on the deep surface of the muscle. This tendon constitutes the insertion of the gluteus maximus to the gluteal ridge of the femur and it was apparent that in these two cases the tendon was in an abnormal state of development.

Dissections on the cadaver show that many cases, with well developed gluteus maximus tendon, might have the latent power to produce the "snapping hip" symptom.

Modern Treatment of the Weak Foot. A. WHITMAN, New York. *Journal of the American Medical Association*, January 17, 1920.

In his army experience, Whitman found that when he first joined the British forces the British liaison officers discouraged the use of mechanical appliances, and when he came into the American Forces later, he found this view adopted by the orthopedic physicians, but they had gone one better than the British, in establishing a camp or battalion for soldiers rejected for active duty on account of weak feet, backs, etc. "There the feet were treated by raising the inner borders of the patient's heels and soles, and occasionally by applying a leather strap about the foot and ankle. Metatarsalgia was treated by a leather bar nailed across the sole behind the heads of the metartarsals. By carefully graded exercises alternated with periods of rest, and by constant supervision and rigid discipline, a very large proportion of these soldiers were returned to combat duty, one of Colonel Goldthwaite's greatest triumphs." The discovery that apparatus was unpractical for soldiers led to the next question as to whether the soldiers were willing to be cured. This was found to be the case with the majority. In civil life, however, at least half the hospital patients with weak feet are women, middle-aged, hardworking housekeepers, suffering also more or less from varicose veins. The men are much of the same class, and there are comparatively no young men or girls, and almost no children, voluntarily seeking treatment for this condition. Of late, however, there have been an increasing number of children brought to the hospitals on account of the ugly appearance of the feet or peculiar gait. Here the problem is quite different from that of military practice, and the main obstacle to successful treatment is the indifference of both patient and physician. Whitman finds in his hospital practice practically no patients who have not previously sought relief and obtained it only temporarily by varied nondescript apparatus which only relieve symptoms without removing the cause. Except in rare cases of congenital flatfoot and accidental deformity, the underlying cause of weak foot is the attitude of eversion of the foot commonly due to the practice of standing and walking with the toes turned out, causing the bodyweight transmitted downward to fall to the inner side of the foot. "This attitude being established, it is only a question of time for the astragalus to begin rolling downward and forward off the os calcis, thereby pressing on the ligaments, causing pain, and ultimately deformity. The mechanism of this process is simplicity itself, and may be demonstrated by dropping a plumb line from the patella, noting where the weight falls when the feet are in the different attitudes." Once this fact is established, it remains only to correct the bad habit, and here we encounter two difficulties—the private patient in civil life is not enough interested in his feet to devote to them the needed amount of thought, and the hospital patient who has to be cured lacks strength in his muscles to maintain the proper attitude continuously. The only apparatus, so far devised, which at once supports and attempts to correct the predisposing habit is that of R. Whitman. It not only "supports the arch" but also provides the lateral pressure needed. If a patient wearing a brace, tries to turn his toes out he becomes uncomfortable and in pulling away from the pressure of the brace he assumes the overcorrected attitude which is intended to become habitual. The patient gives his feet too little consideration. If he is willing to submit to an operation, the prolonged rest in plaster of Paris enables the relaxed ligaments and muscles to contract in the over-corrected position, and the operative scar later is a reminder to follow the surgeon's advice as to gait and posture. Whitman does not claim that this treatment will always be successful, but he gives detailed directions as to the method of fitting the plaster-of-Paris cast. To the average patient, it should be made perfectly clear that his true recovery depends on himself, following out the proper directions. There are three ways, Whitman says, in which the average weak foot can be cured: "(*a*) By proper shoes, plus a rigid supervision of the patient's daily exercise, gait and posture; (*b*) by prolonged rest in plaster-of-Paris with the foot in the over-corrected attitude, plus or minus operative procedure, followed by exercises, etc. (*c*) By the application of a proper brace, combined with daily exercises, etc." He believes that the late experience of the war has aroused physicians to the possibilities of correcting and to an interest in caring for these defects. If we have compulsory military training it will help with the rising generation.

The Surgical Treatment of Exophthalmic Goiter. GEORGE W. CRILE, Cleveland. *Surgery, Gynecology and Obstetrics*, January, 1920.

The principal factors in Crile's system of management are outlined:

1. The differential diagnosis is greatly aided by the Goetsch test and metabolism determinations.
2. The operative procedures are graded according to the severity of the disease.
3. The inhalation anesthesia is nitrous oxid-oxygen, which is administered with the patient in bed; the operation being performed either with the patient on bed or after his transportation, under anesthesia to the operating room.
4. In moderate cases the entire operation may be completed at one séance.
5. In more severe cases the thyroid activity is diminished by a preliminary ligation, with the patient in bed, under nitrous oxid-oxygen analgesia and local anesthesia.
6. In extremely grave cases it may be necessary to diminish the thyroid activity by multiple steps: ligation of one vessel; ligation of the second vessel; partial lobectomy; complete lobectomy—allowing intervals of a month or more between these stages, the length of each interval being determined by the degree of physiologic adjustment.
7. If during the operation, the pulse runs up beyond the safety point, the operation is halted, the wound dressed with flavine, and the operation completed after a day or two when conditions have again become safe. In some cases even though the thyroid has been resected, it is advisable to dress the unsutured wound with flavine and make a delayed suture in bed the following day under analgesia.
8. In certain cases lobectomy is performed while the

patient is in bed under nitrous oxid analgesia and local anesthesia.

9. Psychic control of the patient, on the part of the surgeon, the interne, the anesthetist, and the nurse, is required throughout to diminish the intense drive. An anociated régime should be prescribed for the pre-operative, inter-operative and post-operative periods. The pre-operative and post-operative managements are of almost equal importance to that of the operation itself.

10. If after the operation, the temperature becomes excessively high, with greatly increased pulse and respiration rates, the patient is packed promptly in ice.

11. To avoid the effects of too sudden a withdrawal of thyroid secretion, thyroid extract is given the night before a lobectomy.

Empyema. With Particular Reference to its Pathogenesis and Treatment. ALEXIS VICTOR MOSCHCOWITZ, New York. *Surgery, Gynecology and Obstetrics,* January, 1920.

From a very wide army experience as a member of the Empyema Commission, Moschcowitz presents a scholarly paper on empyemathoracis. His conclusions are as follows:

1. Empyema, in most instances, results from the rupture of a small, subpleural, pulmonary abscess.

2. An empyema is the final stage of a process, on which the first stage is a serous pleurisy, and the second a sero-purulent pleurisy. The latter is the so-called formative stage of an empyema.

3. The formative stage of an empyema is unaccompanied by recent pleural adhesions. The stage of acute empyema is always accompanied by adhesions.

4. The vast majority of empyemata is of the encapsulated variety. Very few occupy the entire pleural space.

5. The treatment of empyema should be begun in the formative stage before the exudate has been converted into frank pus.

6. It is unwise to perform an operation in the formative stage. The mortality is terrific, because the accompanying pneumonia is still in full bloom, and furthermore, because of the absence of adhesions there occurs an acute pneumo-thorax, with fluttering of the mediastinum, and consequent embarrassment of the action of the heart.

7. The best surgical procedure in the formative stage is repeated aspiration, done as often as indicated in order to relieve the embarrassment due to pressure of the rapidly accumulating fluid. In a few cases this measure is even curative.

8. Feeding with a diet rich in calories, is an important adjuvant in the treatment of the formative stage.

9. The treatment in the acute stage of empyema consists in simple intercostal thoracotomy. This operation need not be considered an urgent one and should be performed when the patient's condition is otherwise perfectly satisfactory. This is the so-called late operation.

10. Urgent thoracotomy is indicated only in acute pyopneumo-thorax.

11. The Carrel-Dakin treatment has proved of superlative value in the post-operative treatment of empyema and should be instituted in every case. There are no contra-indications to its use.

12. The mortality of acute empyema by these methods is lower than reported by other methods of treatment.

13. Empyema cavities heal by three methods.
   a. By the formation and absorption of a sterile exudate.
   b. By the formation and absorption of a closed pneumo-thorax.
   c. By the classical method, *i. e.*, expansion of the lung and obliteration of the cavity.

14. Chronic empyema should not occur, or should at least become very rare, if the methods of treatment of acute empyema, as formulated above, are practiced.

15. Chronic cases may therefore be defined as empyemata, which are not amenable to Carrel-Dakin treatment.

16. Recurrences in empyema are usually the result of undue haste in closing the thoracotomy opening. The percentage of recurrences after the Carrel-Dakin method of treatment is less than after any other.

17. The vast majority of operations that have been devised for chronic empyema will have a very limited field of usefulness, if the methods of treatment above advocated are carried out.

The Surgical Treatment of Empyema by a Closed Method. ARVINE E. MOZINGO, Indianapolis. *The Journal of the Indiana State Medical Association,* February, 1920.

When fluid is suspected in the pleural cavity a diagnostic puncture should be made and if fluid is removed in which organisms are present, the operation should be performed immediately.

Under a local anesthetic a trocar cannula should be introduced (into the eighth space post axillary, preferably, if fluid has been found here).

The trocar is removed and a 4 mm. seamless tube introduced into the cavity through the cannula, which is now removed.

The fluid may be removed by connecting the tube to a Potain aspirator or it may be removed by a one-half ounce bulb syringe. The cavity is then cleansed with Dakin's or normal saline solution, depending on the condition of the patient. The tube should extend from 8 to 15 cm. inside the cavity and have fenestrae 2 mm. in diameter every 2 cm. so as to completely empty the cavity. The tube should extend outside the chest about 15 cm. The end of the tube should be capped with a rubber from a medicine dropper to decrease chances for contamination, and held on by a serrefine to maintain negative pressure. Tissue forceps and not the finger should be used in handling the tube.

The negative pressure established by the bulb syringe is sufficient to give maximum expansion to the lung and soon obliterates the cavity. The bulb syringe should always be used in preference to the glass syringe.

If the patient has an active pneumonia with high temperature, saline solution should be used for the first few days every four to six hours. Treatments are given usually every two hours by day and three hours by night. Once daily the cavity should be filled to about one-half the original capacity to prevent pockets from forming. As the condition improves, the Dakin's solution may be substituted for the saline.

The dressing is small and does not hinder free expansion of the chest. A No. 0 safety pin is thrust through the edge of the tube. Two pads 2.5 cm. square are placed one above and one below the pin. A 5 cm. pad is now threaded on the tube and held in place by four adhesive strips, each 5 by 8 cm.

After from two to fourteen days' treatment with Dakin's solution, 2 per cent. formaldehyd in glycerin in injected into the cavity once daily following treatment with Dakin's solution. This treatment is usually continued from three to ten days.

Smears and cultures should be taken only after vigorous agitation of the secretion in the cavity by quick compressions and expansions of the bulb, and no formalin used for at least twenty-four hours previous.

When the secretions have become a clear sero-sanguinous fluid and after negative smears and cultures for three successive days the tube may be removed. From 3 to 10 c.c. of formaldehyd solution should be left in the cavity when the tube is removed to act as a kind of rear guard to prevent recurrence. This solution and the resultant secretion will soon become absorbed. It is well to be governed also by the amount of secretions and sediment.

When the tube is removed care must be observed to prevent air from entering. The sinus is treated with iodin and then closed with adhesive plaster.

Summary of the forty-five acute cases treated by the closed method: Number having a bronchial fistula, 8; number cases requiring secondary operation, 1; number of cases having secondary operation before closed treatment method was completed, 5; number bilateral cases, 4; shortest time tube was in cavity, 4 days; average time tube was in cavity, 25.2 days; number of cases who had tube less than fourteen days, 18; number of recurrences, none; number of deaths (a bilateral), 1; largest amount of pus removed at operation, 7,240 c.c.; average number

of days patient in bed after operation, 7; number of cases having not over three dressings, 20.

The closed method can effect cures in acute bilateral empyema, with a bilateral pneumonia present, both sides being operated at the same time which treatment is impossible by the open method.

Most cases that have become chronic following an open operation can be cured by the closed method in a short time, making unnecessary a major secondary operation of the Schede or Estlander type.

A Case of Lipoma of the Colon. (*Zur Kasuistik der Dickdarmlipome.*) KUNO KOTHNY, Vienna. *Wiener Klinische Wochenschrift*, January 15, 1920.

Submucous lipoma of the digestive tract is comparatively rare. Ehrlich, in 1910, found 52 recorded cases, some anatomical and some clinical observations. Of these 24 were of the colon, and 8 of them were expelled spontaneously. The others were found at autopsy, or operation undertaken to relieve intussusception.

The case recorded by Kothny was a 43-year old man who had been suffering for three months with abdominal cramps of irregular distribution. These, at first, were at intervals of a few days but became more frequent, appearing one to two hours after eating, lasting about an hour and then gradually or suddenly ceasing. In the left iliac region could be felt a firm, fist-sized movable mass, not tender. To exclude the possibility of this mass being scyballous feces, a purge was administered and, as a result, the tumor was expelled, with colicky pain.

It was found to be a goose-egg size lipoma, containing much connective tissue. The mucosa was attached to part of its surface but—as has been found in other cases—part of it was bare of mucous membrane covering.

The patient was relieved of all his symptoms and now, after four years, roentgenography reveals a normal colon shadow.

Some Clinical Types of Abdominal Tuberculosis. K. W. MONSARRAT, Liverpool, England. *The British Medical Journal.* January 3, 1920.

Mansarrat presents cases, showing more or less typical lesions of the ileum, cecum and large bowel, rectum and mesenteric glands. In the ileum, one usually encounters localized ulceration, involving only a small length of the bowel. In the cecum the usual lesion is a massive infiltration, forming a large tumor, with resulting stenosis and intestinal obstruction. In the rectum one sees ulceration, infiltration or abscess formation.

In reference to the treatment of abdominal tuberculosis Monsarrat offers the following suggestions:

1. When tuberculous disease, either of ileum or large bowel, is associated with definite intestinal obstruction, operation is always necessary, and the choice lies between exclusion by anastomosis and excision. If the obstruction is acute, exclusion by anastomosis is to be preferred; if the obstruction is subacute the exact local condition must decide: a mass that is easily isolated is better removed.

2. When such tuberculous bowel lesions are not associated with obstruction, or with an obstruction that is chronic and capable of relief by aperient, the advisability of operation will depend on whether the bowel disease is or is not the sole demonstrable lesion in the body. If the lung is also affected it will probably be wiser to decide against operation.

3. With regard to disease of the rectum the establishment of an artificial anus has been recommended and practised on the ground that keeping the rectum empty affords a better prospect of resistance and recovery. Before recommending this method of treatment we should require a body of evidence that cure of the rectal disease can really be anticipated in a fair proportion of cases. When the rectum is affected above the peritoneal reflection, and is associated with abscess, evacuation of the abscess by the intraperitoneal route is to be recommended, but except for the treatment of this complication operation has no service to offer.

4. Lastly, in selected cases, operation gives good results in limited tuberculous disease of mesenteric glands. According to the extent and stage of the focus this will take the form either of enucleation or of excision of the mesentery involved, together with associated bowel.

Carcinoma of the Bladder. BRANSFORD LEWIS and NEIL S. MOORE, St. Louis. *Urologic and Cutaneous Review*, January, 1920.

The authors report 5 cases of carcinoma of the bladder, successfully treated by radium or *x*-ray. The cures vary from three to four years.

The procedure is as follows: The radium is inserted into a capsule, welded on the end of a silver wire, the whole covered by a black rubber cap. The tumor being definitely located with the cystoscope, the radium is introduced in the applicator, turned and held close to the growth, where it remains for eight to ten hours. Meanwhile, as occasion requires, the patient urinates voluntarily alongside of the catheter. The number and frequency of such applications depend on the individual case, but varies from three to four, at intervals of two to three weeks. X-ray treatments may be used in addition, and both forms of treatment may be used preparatory to fulguration or open operation.

The Application of Radium in Cancers of the Lower Genito-Urinary System. HENRY SCHMITZ, Chicago. *The Urologic and Cutaneous Review*, February, 1920.

Schmitz discusses his methods and results in fifty cases of urinary tumors.

Tumors aside from their locality should be classed as follows, and treated accordingly.

a. Cases clearly operable;
b. Cases doubtfully operable;
c. Cases far advanced and clearly inoperable, in which ray therapy was applied only for purposes of palliation;
d. Cases in which a recurrence occurred following a surgical excision.

Clearly operable cases must be subjected to operation, but should be preceded and followed by ray-therapy. The rays properly applied cause a degeneration of the tumor cells, the chief value of which is a cessation of mitosis. The growth of the tumor is arrested. Should some carcinoma cells be accidentally left behind they probably would be harmless and could not give rise to metastases by way of the lymph—or bloodvessels.

Doubtfully operable cases, the border-line cases, should only be treated with radium. A recession of the growth so it is visibly or palpably smaller, or has become clearly limited to the organ, or has even entirely disappeared does not necessitate a surgical eradication now. If a surgical removal was attempted, either the patient succumbed to the operation or the trauma stimulated the tumor cells to a renewed activity. Intensive ray treatments could not arrest the revived proliferation.

Advanced cancer disease cannot be subjected to ray treatment with any hope of improvement; transitory relief from the symptoms may occur. One must be especially careful in the application of rays in this group of cases. The absorption of the tissue breakdown may cause such a severe autointoxication that the patient with lowered body resistance speedily succumbs to it.

Recurrent cancers should be subjected to excision if it can be safely done. The operation also should be preceded and followed by ray treatment. Otherwise the same rules hold good for recurrent cases as applied to primary border-line and advanced cases.

Late Results of the Radium Treatment of Cancer of the Uterus. J. LOUIS RANSOHOFF, Cincinnati. *Journal of the American Medical Association*, January 17, 1920.

The Wertheim operation, which was considered a step forward, is still on trial after two decades. Contrasted with the high mortality following extensive operations for uterine cancer, there is practically no immediate mortality from radium treatment, and it is available for all classes of cases at all stages of the disease. The immediate results have been good without exception in the author's observation. After two years' absence in army service, he found that of the patients he had seen in the three years prior to his absence, numbering thirty-two in all, 19 per cent. were well and free from all evidence of

disease from nearly three to five years after treatment. In two cases of cancer of the body of the uterus the results were disappointing. Neither of these cases, however, were operable otherwise. Deducting the eight cases in which incomplete series of treatments were given, there was 25 per cent. relief of symptoms during this period, and in no definitely operable case was the treatment unsuccessful. He says, "We have here 19 per cent. of those patients treated from recurrence for from two and one-half to five and one-half years; one patient for five and one-half years; two patients for over four years; one patient for three years, and one for two and one-half years. The latter case may perhaps be a little too recent to be definitely called cured. This percentage of cure may seem small, but it compares favorably with that following operation. Deducting the eight cases in which the treatment was incomplete raises the percentage to 25." If cases were chosen for radium treatment with the same care that they are chosen for operative treatment, Ransohoff thinks the percentage of cures would be very much larger. There is scarcely any case so advanced that some improvement cannot be made. Radium treatment is not in itself fatal while the direct mortality from operation is over 18 per cent.

A New Operation for Suspension of the Uterus. F. G. DU BOSE, Selma, Alabama. *Southern Medical Journal*, January, 1920.

The technic is as follows: "A linen or silk thread on a full curved needle is carried through the broad ligament as a running stitch, close to and immediately underneath the round ligament, beginning at the internal abdominal ring, carried across the fundus of the uterus, engaging superficially under the peritoneal coat, passing underneath the opposite round ligament until the other internal ring is reached. The needle is unthreaded and a ligature carrier is passed through the aponeurosis of the rectus muscle about an inch from the abdominal incision, and on a level with the internal abdominal ring, through the musculature of the anterior abdominal wall until it emerges from the parietal peritoneum at the internal abdominal ring. The linen suture is threaded on the carrier and drawn through the abdominal wall.

The same technique is carried out on the opposite side. Then both ends of the thread are caught and the uterus pulled up to the desired position. Two hemostats are then applied to the thread; one on either side where it emerges from the aponeurosis of the rectus muscle. The peritoneum is then closed, the aponeurosis of the rectus muscle is sutured, and while the forceps are still in position, the linen suspension thread is tied. The placing of the forceps here described prevents the drawing too tightly on the suspension suture, which would bring the uterus too far forward, and possibly so narrow the space between the uterus and the abdominal wall as to result in hernia or obstruction. The hemostats are removed after the tying of the suspension suture. The closure of the abdominal skin incision is then completed.

The operation described has given uniform satisfaction. It has been done more than fifty times without a failure in any instance to correct the retroverted uterus. It has also been used in the milder cases of prolapsus uteri with good results, in all of which cases, however, the repair of the injuries to the pelvic floor has been coincidentally done. It disturbs the anatomy of the pelvic organs in a less degree than any of the other suspension operations. It takes the stress off the attenuated round ligaments and allows them to regain their tonicity, while securely holding the uterus in position. It neither fixes nor interferes with the normal range of mobility in any way. It does not interfere with fecundity, and it is impossible for dystocia to result in the event of pregnancy following this operation.

The area of suspension is equal to the area of support and the point of support is not concentrated in any one peritoneal area, but is uniformly distributed so that it is hard to conceive that any reflex nervous irritation should arise from it. There is now raw surface left to produce adhesions.

The ultimate disposition of the linen thread is to be replaced by a fibrous legamentary cord, due to fibreblasts thrown into the meshes of the linen thread which eventually disappears.

The Use of Free Transplants of the Fascia Lata in Surgery. G. GREY TURNER, England. *The British Medical Journal*, January 17, 1920.

The author refers to numerous opportunities that have occurred, to use fascial transplants in unusual cases. He found the method useful for protecting deep structures such as sutured nerves or tendons during the slow healing of a wound by granulation, or when the superficial tissues were so much damaged that their recovery after suture was likely to be attended by sloughing. Fascial transplant was occasionally useful for the replacement of lost tendons. It should always be used to cover exposed brain, where the membranes are deficient, in order to prevent adhesion to the scalp. In one case the author was able to repair the urethra by means of a free transplant of fascia lata. Suppuration may take place without impairing the visability of the graft. This occurred in one case of arthroplasty, in which the final result was successful.

Local Anesthesia in Neurosurgery. CHARLES E. DOWMAN. Atlanta. *Journal of the American Medical Association*, February 7, 1920.

By extensive experience as chief of a neurosurgical team in the forward area, Dowman became thoroughly converted to the use of local anesthesia in brain and spinal cord operations. Since returning to civil practice he has used it as a routine procedure, excepting in operations on children and very nervous adults, whose cooperation could not be relied on. Preliminary injections of morphin have been used when there was not too great intracranial pressure, and in patients who had been kept under sodium bromid, given four times daily, for several days before operating. The type of local anesthesia used is a massive infiltration with 0.5 per cent. procain, to each ounce of which have been added 15 minims of epinephrin (adrenalin) chlorid solution (1:1,000). This solution is best made up immediately before each operation. For the sake of convenience the powdered procain may be kept in capsules, each capsule containing 5 grains of the drug. The contents of one such capsule added to 2 ounces of boiling water, plus the addition of 30 minims of the epinephrin solution will give a sterile 0.5 per cent. procain-epinephrin solution of sufficient quantity for the average operation. In extensive operations, however, Dowman used as much as 6 ounces of such a solution and never noticed any toxic effects of the drug. The infiltration is made by a long needle and Luer syringe of at least 20 c. c. capacity, the point of the needle extending just through the scalp above the galea. As the infiltration progresses, the scalp is raised by the underlying fluid and the needle can be further inserted during the injection along the line of the proposed incision. The scalp proper cannot be successfully injected. The infiltration is now extended under the galea and into the muscles in those regions in which muscle is present. If sufficient solution is used and at least fifteen minutes allowed to elapse before the incision is made, the patient does not complain of any pain whatsoever. No further infiltration is required if it has been massive enough at first. The skull can be entered painlessly and the brain, of course, is not sensitive. At the base of the brain, the dura may be more or less sensitive. He goes at some length into his use of the method in a radical operation for trifacial neuralgia. He has always adopted the Cushing method of approach, though the Frasier may, he thinks, be equally satisfactory. Two advantages of local instead of general anesthesia are given; first, the absence of extensive hemorrhage embarrassing the operator and, second, the absence of a relatively tense dura. He believes that the routine use of local anesthesia in this as well as other neurosurgical operations gives a larger margin of safety than the use of general anesthesia, and he has no hesitation in recommending the former.

Book Reviews

The Principles and Practice of Roentgenological Technique. By I. SETH HIRSCH, M.D., Director, *X*-Ray Departments, Bellevue, Fordham, Harlem and Gouverneur Hospitals, New York. Quarto; 233 pages; 343 illustrations and 22 tables. New York: AMERICAN X-RAY PUBLISHING CO., 1920.

So important has roentgenography become in medical practice, so many young physicians have recently entered this field as a result of special instruction during the war, that this complete and authoritative work on roentgenological technics is indeed very welcome.

The author has been engaged in roentgenography for many years and has had unusual opportunities for the study of its theories and its practice. This experience he has brought to bear in preparing this comprehensive, practical and profusely illustrated work on the technical side of the subject.

The book is divided into two parts. Part I is devoted to the Principles of Technic, descriptive of the electrical and mechanical principles concerned in the production of the *x*-ray. Part II is devoted to the Application of the Principles of Roentgenological Technic. It discusses *fluoroscopy, the methods of radiography, sterescopy, teleroentgenography, exposure, plate development., etc. Postures and positions* are described and discussed very clearly, and freely illustrated. For each type of picture are given the posture, immobilization and tube distance. *Exposure* occupies a separate chapter. There are also chapters on *examination of the plate* and the *equipment of a roentgen laboratory.*

Adhering closely to his theme, Hirsch gives the mechanics of gastro-intestinal exposure, but not details of barium-meal administration nor interpretation, he details the manner of making exposures of the genito-urinary tract but does not describe pyelography. We can not criticise this, but we think it unfortunate that the author omits discussion of the localization of foreign bodies, the mathematical and mechanical considerations of which seem to us to belong within the scope of a work on roentgenologic technics.

There is a complete description of Christen's half-value absorption theory, which is perhaps destined to be the fundamental method for measurement of *x*-ray dosage. The technics of roentgenotherapy, however, are not considered in this work.

We know of no better work in English on roentgenologic technic. Supplemented by a good atlas and by such a book as Holmes and Ruggles' on Roentgen Interpretation, it will provide an authoritative and reliable basis for the novitiate and an excellent reference for the more experienced.

La Rachianesthesie Generale. Par le Professeur THOMAS JONNESCO, Ancien Recteur de l'Université de Bucarest. Duodecimo; 126 pages; paper bound. Paris: MASSON & CIE., 1919.

Jonnesco believes that by the addition of strychnine to the injection of stovaine spinal anesthesia is made as safe and as satisfactory for the upper as for the lower parts of the body. This booklet, descriptive of his methods and contentions, was long delayed in publication by the outbreak of the war. Jonnesco's upper spinal injection has no following in this country, where he demonstrated it several years ago.

Les Lésions Des Nerfs. Traitement et Restauration. MME. ATHANASSIO-BENISTY. Ancien Interne des Hopitaux de Paris. Duodecimo; 156 pages; 66 illustrations. Paris: MASSON ET CIE., 1919.

As we remarked editorially (December, 1919) Mme. Athanassio-Benisty's publications are among the most important war contributions to medicine. English editions of this book and of her Clinical Forms of Nerve Lesions, prepared by E. Farquhar Buzzard, were published in 1918 by the University of London Press and Masson et Cie.

Venereal Diseases. A Practical Handbook for Students. By C. H. BROWNING, M.D., D.P.H., Director of the Bland-Sutton Institute of Pathology of the Middlesex Hospital, and DAVID WATSON, M.B., C.M., Lecturer on Venereal Diseases, Glasgow University; Surgeon in Charge of the Venereal Department, Glasgow Royal Infirmary and of the Lock Hospital, Glasgow, with an introduction by SIR JOHN BLAND-SUTTON, F.R.C.S. Duodecimo; 336 pages; illustrated. London: HENRY FROWDE, HODDER & STOUGHTON. OXFORD UNIVERSITY PRESS, 1919.

This is a convenient student's manual on syphilis and gonorrhea, descriptive of these diseases in their various stages and as they affect different organs of the body. There is a chapter on urethritis simplex (non-gonorrheal urethritis); but chancroid is not described. An appendix contains instructions for the performance of the Wassermann test and for the preparation of Gram's stain.

"Wade in, Sanitary!" The Story of a Division Surgeon in France. By RICHARD DERBY, Lt. Col., M. C., U. S. A., Division Surgeon, Second Division Illustrated. New York: G. P. PUTNAM'S SONS, 1919.

Although dealing chiefly with his own activities and those of the Sanitary Train of the Second Division, Dr. Derby has, in effect, here written an interesting chronicle of that famous division in the A. E. F.

Food for the Sick and the Well. How to Select It and How to Prepare It. By MARGARET P. THOMPSON. R. N. Duodecimo; 82 pages. Yonkers, N. Y.: WORLD BOOK CO., 1920.

A convenient little manual of recipes and instructions.

Books Received

Injuries to the Head and Neck. By H. LAWSON WHALE, M.D. (Camb.), F.R.C.S. Eng. Capt. R.A.M.C. (T.F.), formerly Capt. I.M.S. (Retired); The Queen's Hospital, Sidcup; No. 83 General Hospital; and Surgical Specialist to No. 53 General Hospital, B.E.F.; Surgeon for the Ear, Throat and Nose to the London Temperance Hospital; and to the Hampstead General Hospital. With Preface by COLONEL FREDERICK F. BURGHARD, C.B., M.D., M.S., F.R.C.S. Small octavo; 316 pages; 130 illustrations. New York: PAUL B. HOEBER, 1919.

Physical Reconstruction and Orthopedics. By HARRY EATON STEWART, M.D., Captain Medical Corps, U. S. Army, Division of Orthopedics; Assistant Director, Section of Physiotherapy, Surgeon General's Office; Instructor in Medical and Orthopedic Gymnastics and Massage, New Haven Normal School of Gymnastics; Attending Surgeon, New Haven Orthopedic Dispensary; Formerly Instructor in Corrective Gymnastics, Teachers College, Columbia University. Authorized for Publication by the Surgeon General of the U. S. Army. Octavo; 234 pages; 67 illustrations, 2 diagrams. New York: PAUL B. HOEBER, 1920.

The Narcotic Drug Problem. By ERNEST S. BISHOP, M.D., F.A.C.P., Clinical Professor of Medicine, New York Polyclinic Medical School; Member Narcotic Committee, Conference of Judges and Justices of New York State, etc. Duodecimo; 136 pages. New York: THE MACMILLAN COMPANY, 1920.

Collected Papers of the Mayo Clinic, Rochester, Minn. Edited by MRS. H. H. MELLISH. *Volume X.* 1918. Octavo; 1196 pages; 442 illustrations. Philadelphia and London: W. B. SAUNDERS COMPANY. 1919.